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The issue and category number which previously followed the NASA accession number in the indexes (e.g., 01-24) has been replaced in the individual issues with a category number only (e.g., c24). The cumulative indexes will list the issue and page number (e.g., 01 p0115) as an aid in locating the abstract more readily.

Edge marking provides direct access to the beginning of each subject category in the abstract section as well as to the beginning of each index. The edge marking is visible when *STAR* is bent so that the unbound margin fans out.

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- Scientific and technical reports of government agencies, universities, and research organizations throughout the world.

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Organizations having a NASA contract may obtain *IAA* by writing NASA, Code ATSS-A, Washington, D.C., 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N.Y., 10017.

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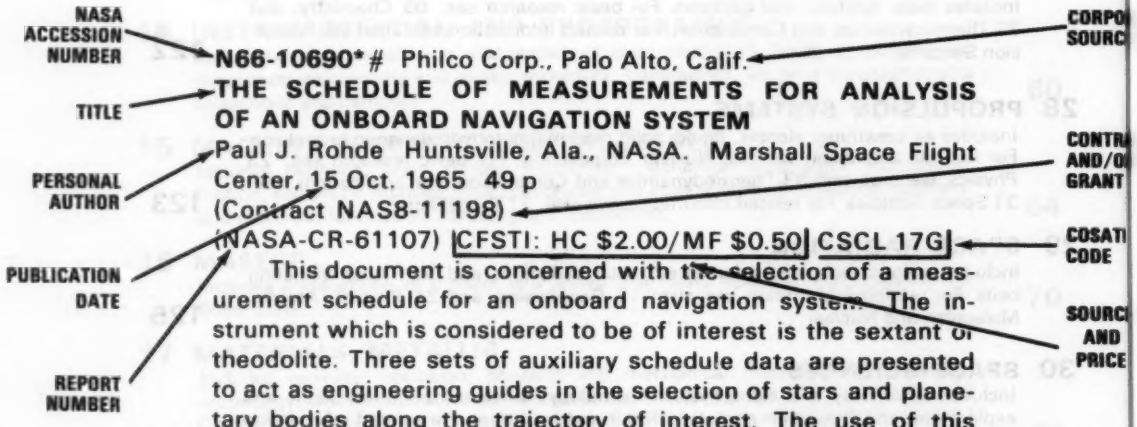

N66-10690*# Philco Corp., Palo Alto, Calif.
THE SCHEDULE OF MEASUREMENTS FOR ANALYSIS OF AN ONBOARD NAVIGATION SYSTEM
Paul J. Rohde Huntsville, Ala., NASA. Marshall Space Flight Center, 15 Oct. 1965 49 p
(Contract NAS8-11198)
(NASA-CR-61107) CFSTI: HC $2.00/MF $0.50 CSCL 17G

This document is concerned with the selection of a measurement schedule for an onboard navigation system. The instrument which is considered to be of interest is the sextant or theodolite. Three sets of auxiliary schedule data are presented to act as engineering guides in the selection of stars and planetary bodies along the trajectory of interest. The use of this auxiliary data is demonstrated along a round trip Mars trajectory and a lunar trajectory. The value of using the auxiliary data as a guide is verified by obtaining tracking schedule evaluation data from a digital computer simulation of an onboard tracking system. Author

TYPICAL CITATION AND ABSTRACT FROM *STAR*

VOLUME 4 NUMBER 1

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N66-10094# Aeronautical Research Council (Gt. Brit.)
MECHANICAL ASPECTS OF TURBINE BLADE COOLING
London, HMSO, 1965 52 p refs
(ARC-R&M-3404) HMSO: £1 2s

CONTENTS:

1. DESCRIPTION OF AN EXPERIMENTAL HIGH-TEMPERATURE TURBINE AND ASSOCIATED TEST RIG (COOLED TURBINE NO. 126) N. E. Waldren and J. A. Flint p 1–20 refs (See N66-10095 01-01)

2. THE BEHAVIOUR OF EXTRUDED AIR-COOLED ROTOR BLADES SUBJECTED TO STEADY HIGH TEMPERATURE AND ROTATIONAL SPEED J. F. Barnes, J. E. Northwood, and D. E. Fray p 21–51 refs (See N66-10096 01-01)

N66-10095 Aeronautical Research Council (Gt. Brit.)
DESCRIPTION OF AN EXPERIMENTAL HIGH-TEMPERATURE TURBINE AND ASSOCIATED TEST RIG (COOLED TURBINE NO. 126)
N. E. Waldren and J. A. Flint *In its* Mech. Aspects of Turbine Blade Cooling 1965 p 1–20 refs (See N66-10094 01-01) HMSO: £1 2s Supersedes NGTE-R-237; ARC-21504
(NGTE-R-237; ARC-21504)

Part I of this report describes an experimental, cooled turbine, designed and built for research into problems associated with the operation of turbines at very high gas temperatures, in particular, the problem of turbine blade cooling. The turbine structure and the associated test rig have been designed to permit testing of turbine blades over a wide range of turbine entry gas temperature from 900° K to 1600° K and entry gas pressure from 2/3 to 5 atmospheres gaving a wide range of gas-flow Reynolds numbers to the baldes. A further aim of the design has been to achieve rapid access to blades under test and to allow the testing of a moderately wide variety of both blades and cooling systems with relatively minor alteration to the turbine or test rig. Initial proving tests have been made to observe the mechanical behavior of the turbine and test rig and to establish optimum coolant quantities required to cool the turbine structure. Following minor alterations and adjustments satisfactory performance was achieved over the major portion of the design speed range while operating at moderate gas temperatures, from 900° K to 1100° K (atmospheric turbine exhaust). Results suggest that the turbine structure should be sufficiently well cooled to permit the testing of blades over the full range of turbine inlet gas temperature envisaged. Author

N66-10096 Aeronautical Research Council (Gt. Brit.)
THE BEHAVIOR OF EXTRUDED AIR-COOLED ROTOR BLADES SUBJECTED TO STEADY HIGH TEMPERATURE AND ROTATIONAL SPEED
J. F. Barnes, J. E. Northwood, and D. E. Fray *In its* Mech. Aspects of Turbine Blade Cooling 1965 p 21–51 refs (See N66-10094 01-01) HMSO: £1 2s Supersedes NGTE-R-251; ARC-24567
(NGTE-R-251; ARC-24567)

Part II of this report describes the results of an endurance test at a gas inlet total temperature of 1500° K. Eighty hours of running were completed at a rotational speed of 12 000 rev/min with a rotor-blade cooling air flow, equal to 1·8 percent of the main gas flow, supplied to the rotor assembly at an inlet temperature of 310° K. During this period three blades failed in a manner similar to that predicted, and other blades exhibited spanwise cracks. A method for estimating the redistribution of combined thermal and centrifugal stress in a non-uniformly cooled rotor blade due to creep effects is described and its predictions compared with observations. Author

N66-10330*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A NUMERICAL METHOD FOR CALCULATING NEAR-FIELD SONIC-BOOM PRESSURE SIGNATURES
Wilbur D. Middleton and Harry W. Carlson Washington, NASA, Nov. 1965 11 p refs
(NASA-TN-D-3082) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A numerical method, based on the modified linear-theory analysis of G. B. Whitham, is presented for calculating the complete pressure field of supersonic projectiles of equivalent bodies representing airplane configurations. The method does not involve graphical solutions and is easily adaptable to digital-computer techniques. A description of the method is given and its application is illustrated by use of examples. Author

N66-10410*# National Aeronautics and Space Administration, Washington, D. C.
WIND-TUNNEL TESTS OF THE GROUND EFFECT ON AIRCRAFT MODELS [ETUDE EN SOUFFLERIE DE L'EFFET DE SOL SUR MAQUETTES D'AVIONS]
Alexandre de Sievers Oct. 1965 37 p Transl. into ENGLISH of paper presented at the Conf. on Appl. Aerodynamics, AFITAE(ENSA), Paris, 12–13 Nov. 1964
(NASA-TT-F-9709) CFSTI: HC $2.00/MF $0.50 CSCL 01B

A critical evaluation of a method of representing the ground by a fixed flat plate (called the floor method) in wind tunnel tests on aircraft models is given. A comparison of results

obtained by the floor method and a mirror image method indicates that the fixed floor procedure leads to greatly erroneous results if aircraft models equipped with wings of weak sweepback are involved. Conversely, relatively close values of the ground effect can be obtained with the floor method if models of strong sweepback are used. The increments in lift and in aerodynamic fineness ratio, resulting from the ground effect, are accurately obtained by the floor method, even when the wing has hyperlift and when the mockup is provided with a rear tail unit. Photographs visualizing the ground effect with both the floor and mirror-image methods are given along with other photographs of models used, and various schematic diagrams depicting the tests. L.S.

N66-10513# Aeronautical Research Labs., Melbourne (Australia).
A METHOD FOR THE ESTIMATION OF GUST LOADS IN A FLEXIBLE AIRCRAFT
R. W. Traill-Nash and M. G. Chandivert Jan. 1965 91 p refs
(ARL/SM-299) CFSTI: HC $3.00/MF $0.75

Equations of motion are derived for a flexible aircraft subjected to a uniform vertical gust. A lumped-mass segmented representation is initially adopted and body freedoms are admitted in vertical displacement and pitch, and in variation in forward speed. Thrust is assumed constant. Strip theory is assumed for the aerodynamic forces and the Wagner and Küssner lag functions for each segment are appropriate to the local chord and are approximated by exponential forms. The delays of swept back segments and tail segments in reaching the gust front are taken into account. Transfer functions are derived for motional response and for structural loading. The simplified case with quasi-steady motional forces is also studied in order to illustrate more simply the essential form of the solutions and a numerical example is worked out on this basis. Author

N66-10659# France. Office National d'Etudes et de Recherches Aérospatiales, Chatillon-sous-Bagneux.
THE FLOATING PROBLEMS OF LIGHT AIRPLANES [LES PROBLEMS DE FLOTTEMENT DES AVION LEGERS]
Henri Gauzy 1965 19 p In FRENCH Presented at the 7th Intern. Aeron. Congr., Paris, 14–17 Jun. 1965
(TP-226(1965)) CFSTI: HC $1.00/MF $0.50

The aeroelastic behavior of light aircraft and gliders is considered in terms of the effect of the fundamental frequency of the control flaps. An examination of aircraft structure and performance is made, and it is concluded that floating characteristics may be improved by aircraft balancing. A brief examination is made of the case of non-linear flaps. Transl. by G.A.L.

N66-10746*# Midwest Research Inst., Kansas City, Mo.
EFFECTS AND IMPORTANCE OF PENETRATION AND GROWTH OF LIFT ON SPACE VEHICLE RESPONSE
Robert R. Blackburn and A. D. St. John Washington, NASA, Nov. 1965 150 p refs
(Contract NAS8-11012)
(NASA-CR-326) CFSTI: HC $5.00/MF $1.00 CSCL 01A

The wind induced responses of the Saturn C-5 without fins are calculated with three aerodynamic representations. The most accurate representation uses unsteady aerodynamics and accounts for penetration into the gusts. The second uses pseudo-steady aerodynamics and accounts for penetration. The third uses pseudo-steady aerodynamics and assumes equal wind cross flows over the missile length. The responses, which include two sloshing and two bending modes, are affected by penetration to a detectable but insignificant degree. The use of unsteady aerodynamics causes very little change. The conventional, third aerodynamic representation provided in these cases slightly conservative (large) responses. Author

N66-10762# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALOGY BETWEEN CYLINDRICAL EXPLOSION AND HYPERSONIC GAS FLOW PAST BODIES
V. P. Korobenynikob 10 Aug. 1965 13 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 6, 1962 p 45–49
(FTD-TT-65-981/1+2; AD-620763)

It is well known that the results of solution to the problem of cylindrical point explosion in a gas may be used to approximately determine a number of characteristics of flow during stationary hypersonic flow past thin blunt bodies. A comparison of results of explosion theory has been carried out previously taking into account the problem of flow past a blunt cylinder for the case of a self-similar explosion without considering back pressure or with a linearized problem concerning explosion taking account back pressure. An approximate method is presented for determining the law of motion of a shock wave and pressure at the explosion center; a comparison is made of these calculations with those made in flow past problems. Author (TAB)

N66-10771# IIT Research Inst., Chicago, Ill. Technology Center.
DEVIATORIC EFFECTS IN HIGH INTENSITY STRESS WAVES Technical Report, 19 Mar. 1963– 20 Nov. 1964
E. L. Mc Dowell Kirtland AFB, N. Mex., AF Weapons Lab., Aug. 1965 71 p refs
(Contract AF 29(601)-5008)
(AFWL-TR-65-15; AD-620334)

The governing equations for dynamic cavity expansion are developed for continua which can be characterized as compressible elasto-plastic, and kinematic hardened. A numerical procedure for integrating these governing equations, utilizing shock-fitting as opposed to artificial viscosity for numerical stability, is outlined. The shockfitting, as well as the starting procedure, is based on a progressive wave solution of an adjunct problem which is asymptotic to the formulated problem. Continua theory of dynamic cavity expansion, as formulated here indicates that the hydrostatic component of the stress state decreases much more rapidly than a decreasing cavity pressure as long as the cavity is expanding. The capability of a continuum to transmit radial compressive force is due to a rapidly increasing deviatoric stress. Author (TAB)

N66-10806# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
AERODYNAMICALLY GENERATED SOUND Final Scientific Report
H. S. Ribner Dec. 1964 21 p
(Grant AF-AFOSR-223-64)
(AFOSR-65-1029; AD-620338)

The research accomplishments of the project are summarized. A study of surface motion in turbulence-induced panel vibration demonstrated that panel motion consists of running waves forced by the convected pressure field superposed on a more irregular pattern. Turbulent structure in the transition region. (4.5 to 8 diams downstream of the nozzle) of a 4-in. low-speed jet was investigated with the aim of relating the turbulence to the noise generating features of such a jet. Progress has been made in improving the accuracy of the hot-wire and time-delay correlator instrumentation, and timing, gate, and relay circuits were developed to

semi-automatic data processing. Constant temperature hot-wires were found to obey a sine law quite accurately over a wide range when inclined to the stream. An aerofoil probe for measuring the transverse component of turbulence was also developed. Lastly, an anomaly in the directivity pattern of jet noise was resolved. Measurements in an anechoic room with a harmonic point sound source placed in an air jet indicated that the sound appears to be refracted away from the jet axis. This gives a marked dimple in the sound directivity pattern very similar to the dimple found with random jet noise. Author (TAB)

N66-10861# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

NEWTONIAN STATIC AND DYNAMIC AERODYNAMIC COEFFICIENTS FOR AN ASYMMETRIC BODY IN PLANAR MOTION

D. A. Coulter, W. B. Brooks, and J. M. Calligeros Jun. 1965 86 p refs

(Contract AF 04(694)-427)

(ASRL-121-9; AD-619994)

The governing equations and a computer program are developed which calculate the static and dynamic aerodynamic coefficients for bodies composed of right circular cone frusta. The resulting combined body possesses one plane of symmetry and the coefficients are referred to that plane. The center of gravity and the moment reference point are arbitrary locations in the plane of symmetry. Flow shielding for the complete angle of attack range is considered for each frustum segment, but mutual shielding of one segment on another is neglected. The effect of any gap-overlap region at the junctions of rotated segments is also neglected. Example calculations are presented for an asymmetric conical body and an asymmetric cone-cylinder-flare configuration. Author (TAB)

N66-10900# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

PRESSURE MEASUREMENTS AT MACH 8 ON AN AERODYNAMICALLY CONTROLLABLE WINGED RE-ENTRY CONFIGURATION. PART OF AN INVESTIGATION OF HYPERSONIC FLOW SEPARATION AND CONTROL CHARACTERISTICS

Lawrence Meckler Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jun. 1965 483 p refs

(Contract AF 33(616)-8130)

(FDL-TDR-64-124; AD-620959)

Pressure data were obtained at Mach 8 for a winged re-entry configuration having aerodynamic controls. The basic model consisted of a clipped delta wing with an overslung cone-cylinder body. The main controls tested were partial span trailing edge flaps. Data were also obtained on the effect of tip fins, hemisphere-cylinder body and a trailing edge spoiler. The data were obtained over an angle of attack range of −50 deg. Due to load limitations on the controls the unit test section Reynolds number varied from 3,300,000 at low angle of attack to 2,500,000 at high angle of attack. Author (TAB)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N66-10147# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Flight Test.

INSTRUMENTATION AND OPERATIONS FOR GATHERING THUNDERSTORM DATA WITH AN F-100F AIRCRAFT DURING THE 1963 NATIONAL SEVERE STORM PROJECT

Ellie B. Underwood Feb. 1964 35 p refs

(ASD-TDR-64-77; AD-435006)

Equipment to measure meteorological phenomena inside thunderstorms was designed, fabricated, installed, and operated in an F-100F jet fighter aircraft, and chaff was dropped into storms for study by ground radar from an RB-47 jet bomber aircraft, in conjunction with the National Severe Storm Project near Oklahoma City, Oklahoma. Devices which were used for the first time in this environment were those used to measure continuously differential static pressure and liquid water temperature, and to determine the presence of ice crystals and icing conditions. Other parameters recorded were normal acceleration, vertical gust velocity, free air temperature, liquid water content, electric field strength, hail mass, and static discharge current. The data collected during the ASD flight test program is archived with the U. S. Weather Bureau, and can be obtained through the National Severe Storm Project.

Author (TAB)

N66-10225# Ritchie and Associates, Inc., Dayton, Ohio.

DISPLAY PROBLEMS IN INSTRUMENT APPROACH AND LANDING

Lewis F. Hanes and Malcolm L. Ritchie Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jun. 1965 102 p refs

(Contract AF 33(657)-7665)

(RTD-TDR-63-4000; AD-620177)

This report contains a summary of two display research efforts. One program is concerned with presentation of information to the pilot while the transition from instrument (IFR) to visual (VFR) flight conditions is made during the final segment of the approach just prior to touchdown. The second program deals with presentation of information to the pilot during the approach and landing when weather conditions preclude visual contact with the runway. The aims of both efforts are (1) identification of major display problems, and (2) recommendations for action by which problem solutions can be obtained. Author (TAB)

N66-10603*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

OPERATIONAL AND PERFORMANCE CHARACTERISTICS OF THE X-15 SPHERICAL, HYPERSONIC FLOW-DIRECTION SENSOR

Chester H. Wolowicz and Terrence D. Gossett Washington, NASA, 21 p refs

(NASA-TN-D-3070) CFSTI: $1.00/MF $0.50 CSCL 01D

The basic design concepts, operational experiences (malfunctions, system characteristics, and system improvements), and flight-data measurements of the sensor are discussed and analyzed. The accuracy of the sensor in measuring angle of attack and angle of sideslip is assessed on the basis of an analysis of flight data and comparisons of these data with X-15 wind-tunnel data. Some practical limitations in the use of the sensor for extreme altitude applications are also considered. Author

N66-10622# Wyle Labs., Huntsville, Ala. Testing Div.

BASIC MECHANISMS OF NOISE GENERATION BY HELICOPTERS, V/STOL AIRCRAFT, AND GROUND EFFECT MACHINES

M. V. Lowson May 1965 38 p Presented at the Symp. on Noise and Loading Actions on Helicopters, V/STOL Aircraft and Ground Effect Machines, Southampton, England, 30 Aug.–3 Sep. 1965
(WR-65-9)

The basic mechanisms of noise generation due to mass introduction, applied force and applied stress are discussed with reference to their implications for helicopters, V/STOL aircraft, and Ground Effect Machines. The significance of the dimensional dependence of monopole, dipole and quadrupole fields is shown. The results of a new theory giving the effects of system accelerations on noise are presented. This theory will often have application to noise problems for these machines because of the centrifugal accelerations associated with many of the noise generating components. System accelerations give rise to higher order poles in the sound field which become particularly important at high speeds. An expression for the sound field produced by fluctuating lift and drag forces in a rotating and convected system is given. As a further example of the application of the general theory the sound field radiated by a hovering helicopter is analyzed. It is shown how a previously unrecognized source of sound arises from the outward components of force induced by the effects of blade coning angle and lag. The source of sound has its maximum in the plane of the rotor disc. The importance of including the proper momentum terms in calculations of noise radiated by moving mass sources is demonstrated. Author

N66-10830# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF THE EFFECT OF SIMPLIFIED EQUATIONS OF MOTION AND VARIOUS INPUTS ON AUTOMATIC-THROTTLE DEVICES
Ronald E. Evans and Robert H. Schuppe (M.S. Thesis) 1964 142 p refs
(AD-621548)

This is the second in a series of investigations of automatic-throttle compensation systems. Landing condition speed instabilities are usually associated with modern supersonic aircraft design. The full airframe equations of motion give accurate results but are much too complicated. The simplification of assuming a zero moment of inertia is made. To test the validity, analog computer results are compared with those obtained with the full equations. Attempts are made to gain a better response by sensing different automatic-throttle input variables. Author (TAB)

N66-10839 Walker (Norman K.) Associates, Inc., Bethesda, Md.
HEAVE STABILITY AND HEAVE DAMPING OF GROUND EFFECT MACHINES—THICK ANNULAR JET AND PLENUM TYPES Final Report
Norman K. Walker and David A. Shaffer Jul. 1965 121 p refs
(Contract DA-44-177-AMC-19(T))
(USSAVLABS-TR-65-26; AD-621515)

The report describes an experimental investigation of the heave stability and heave damping characteristics in hovering flight of an electrically powered model Ground Effect Machine, arranged firstly with a thick annular jet and, secondly, as a simple plenum chamber. The lift, rise height and power relationship were determined and the fan characteristics of the thick annular jet were measured. Air was bled from and fed into the air cushion to evaluate the GEM's change in lift. Finally, the machine was allowed to hover at a specific height and then forced to oscillate. From this the heave stiffness and damping ratio were determined. The results show that the physical basis of the theory is correct and that good estimates may be made of the heave characteristics. However, it is suspected that other derivatives may be present, especially in the case of the plenum chamber, where unstable oscillations in a narrow attitude band were observed, and in any case the measured value of 2 damping ratio/undamped frequency in heave was much less than theory would predict. It is considered that the latter result was not due to an unstable fan characteristic, but rather to an instability of flow in the plenum chamber itself. Author (TAB)

N66-10915# Southwest Research Inst., San Antonio, Tex.
PRELIMINARY LITERATURE SURVEY: STUDIES OF THE STRUCTURAL RESPONSE OF SIMULATED HELICOPTER ROTOR BLADES TO RANDOM EXCITATION Interim Technical Report No. 1
John F. Dalzell and John F. Gormley Sep. 1965 17 p refs
(Contract DA-31-124-ARO(D)-375)
(AROD-5598-1; AD-471209)

The extent and results of the preliminary literature search on the Structural Response of Simulated Helicopter Rotor Blades to Random Excitation are summarized. The objective of the survey was to assess better what data and analytical techniques are available and to verify as far as possible, our original conclusion that the contemplated experimental work has not been, or is not being, duplicated. No indication was found that the program presently envisioned will duplicate existing work. By-and-large, the necessary analytical background appears available; the major problems in the present program remain in the realm of experimental technique. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N66-10049*# Cook Electric Co., Dayton, Ohio.
TESTING AND EVALUATION OF NICKEL-CADMIUM SPACECRAFT-TYPE CELLS Semiannual Technical Report, 1 Jan.–1 Jul. 1965
I. F. Luke and E. A. Roeger, Jr. [1965] 94 p ref *Its* Rept.-9PD-4667-1
(Contract NAS5-9073)
(NASA-CR-67580) CFSTI: HC $3.00/MF $0.75 CSCL 10A

The object of this report is to present the technical status of the cycle-life tests on nine cell groups of spacecraft-type nickel-cadmium cells. The nine cell groups include five groups of cylindrical cells rated at 3.5 ampere-hours from two manufacturers and four groups of rectangular cells rated at 6.0 ampere-hours from another manufacturer. Three groups of cells are being cycled at a temperature of −10° C, one group of the rectangular cells is being cycled at 50° C and the remaining groups are being cycled at 25° C. One group of the cylindrical cells cycling with a 25% depth of discharge at 25° C failed at 12 592 life cycles during this report period. The remaining groups have completed approximately 13 500 life-cycles. The life-cycling is continuous with 60-minute charge periods and 40-minute discharge periods. Author

N66-10198# Minnesota Mining and Mfg. Co., St. Paul, Minn. Thermoelectric Products.
300 WATT PORTABLE THERMOELECTRIC GENERATOR Monthly Progress Report, Period Ending 31 Jul. 1965

R. D. Carlton [1965] 6 p
(Contract N600(61533)62758)
(MPR-10; AD-619718)

Assembly of the first prototype 300 watt generator was completed and testing begun. Upon initial start-up two or more short circuits developed between the main section of the thermopile and the case. Information on thermopile performance was obtained from the 27 couple fan circuit which was isolated from the main thermopile and the case. Power output from the fan circuit was 34.2 watts at average junction temperatures of 1100° F and 300° F. This implies a gross power output from the entire thermopile (270 couples) of 342 watts. Average fin base temperature on the heat sink was 250° F, as predicted. Fuel consumption was approximately 1.45 lbs/hr which is somewhat greater than anticipated but it is felt that this can be reduced by modifications to the burner. Author (TAB)

N66-10234* Radio Corp. of America, Princeton, N. J.
THE SPACECRAFT POWER SUPPLY SYSTEM
T. R. Wylie, P. J. Callen, G. Zielinski, E. Holloway, L. Pessin et al *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 171–189 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1272)

The solar-array, storage battery power supply system for the Relay I spacecraft was designed to permit a minimum of 100 minutes of microwave communication per day. Silicon solar cells converted solar rays to electrical energy while the spacecraft was illuminated; a nickel-cadmium storage battery supplied power during eclipse periods. Battery power could also be used to supplement solar power when necessary. The solar panel substrate is pictured and discussed; array arrangement and array power output are considered; and the storage battery's capacity and charge controller are detailed. Electrical test data are given for the high power and low power voltage regulators; and the voltage limiter, which is a shunt regulator that provides protection for all circuitry connected to the solar bus, is considered. The one-year timer, an electrochemical device to open the solar array bus and thus deactivate the spacecraft after one year in orbit, is powered by a 9-volt zener supply, and weighs 0.3 lb. M.W.R.

N66-10552*# General Dynamics/Astronautics, San Diego, Calif.
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
J. A. Steele 30 Nov. 1965 31 p refs Revised
(Contract NAS1-2934)
(NASA-CR-67600; GD/A-64-26211, Rev. A) CFSTI: HC $2.00/MF $0.50 CSCL 06K

The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed. E.E.B.

N66-10601*# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
RESEARCH AND DEVELOPMENT OF OPEN-CYCLE FUEL CELLS Fourth Quarterly Progress Report, Period Ending Aug. 15, 1965
R. Desai, G. Monette, and C. Williams 15 Sep. 1965 24 p
(Contract NAS8-5392)
(NASA-CR-67802; NAS-8-5392-QPR-004) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Modification and extension of the existing digital computer program for minimizing the weight of fuel cell power systems has been completed and design charts are presented. The study of prelaunch startup and instrumentation has been completed. The computer program for the mathematical representation of the static vapor pressure method of water removal has been debugged. The results of a study to compare the reliabilities of various series parallel fuel cell configurations are given in chart form. An analysis to compare the performance of series versus parallel systems is presented. Author

03

N66-10613*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
INVESTIGATION OF THIN DIELECTRIC FILMS FOR ENERGY CONVERSION Final Report
26 Jul. 1965 143 p refs
(Contract NAS2-1995)
(NASA-CR-67828; AAD-51255) CFSTI: HC $4.00/MF $1.00 CSCL 10A

Experimental and analytical investigations of the thermoelectrostatic solar energy conversion cycle are described. Consideration of withdrawal effects of electrical energy during energy conversion show that for conversion efficiency, the dielectric must support an electrical field of sufficiently large value as expressed in material parameters, but that beyond a specific value, there is little value in greater dielectric strength. Plastic films are shown to be superior to ferroelectrics when power per unit weight is computed. Thermodynamic and switching cycles are analyzed to identify the best process design for energy conversion. The loss factor in a plastic film is shown to be a favorable parameter in thermoelectrostatic energy conversion. Plastic materials and ferroelectrics showing higher values of beta and best retention of resistivity with increasing temperature were identified. The largest energy conversion ratio values were obtained from composite or single films showing capacitance change and a pyroelectric type of voltage generation with temperature. Unambiguous energy conversion was demonstrated with mylar-lexan composite films in a space environmental chamber without having to correct for internal leakage. R.N.A.

N66-10638*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
RADIATION EFFECTS ON SILICON SOLAR CELLS Fourth Monthly Progress Report, Apr. 1–30, 1962
V. A. J. van Lint and E. G. Wikner 8 May 1962 4 p
(Contract NAS7-91)
(NASA-CR-67648; GACD-3160) CFSTI: HC $1.00/MF $0.50 CSCL 10A

An analysis of recombination phenomena in semiconductors was performed, with emphasis on the relation between semiconductor parameters and experimental observables. Irradiations were performed on silicon with high energy electrons to make measurements of conductivity and Hall coefficient. Also, irradiations were conducted on silicon with high energy electrons to make measurements of recombination rates as a function of temperature and radiation. It was established that the minimum rf interference noise was observed in the signal leads when a good ground point was placed directly on the sample. Grounding one of the voltage leads was shown not to be adequate, because the voltage contact was partially rectifying. Grounding a thermocouple which was attached securely to

one end of the sample appeared to be most effective. Other sources of noise were associated with the dc power supply which supplied current to the sample. Appropriate filtering near the sample decreased these noise sources. R.W.H.

N66-10645*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
RADIATION EFFECTS ON SILICON SOLAR CELLS Third Monthly Progress Report, Mar. 1–31, 1962
D. M. J. Compton and V. A. J. van Lint 9 Apr. 1962 3 p
(Contract NAS7-91)
(NASA-CR-67633; GACD-3082) CFSTI: HC $1.00/MF $0.50 CSCL 10A

The preparations for the irradiation experiments were continued. Samples of n-type silicon with phosphorus doping, floating-zone and pulled material, were prepared for accelerator irradiations. The data were reduced from one sample of pulled silicon which was irradiated at room temperature, and the carrier lifetime was measured as a function of temperature before, during, and after irradiation. The temperature dependence of the lifetime after irradiation indicated a slope with an activation energy of 0.16 ev, in reasonable agreement with the activation energy for the A center. An analysis was also performed to predict the temperature dependence on the Hall coefficient, carrier mobility, and lifetime for an assumed set of concentrations of dopants and A centers. R.W.H.

N66-10646*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
RADIATION EFFECTS ON SILICON SOLAR CELLS Final Report, Dec. 1, 1961–Dec. 31, 1962
V. A. J. van Lint, J. W. Harrity, H. Horiye, S. W. Kurnick, D. K. Nichols et al 15 Feb. 1963 129 p refs
(Contract NAS7-91)
(NASA-CR-67632; GA-3872) CFSTI: HC $4.00/MF $1.00 CSCL 10A

Experiments have been performed to study the defects introduced into silicon by high energy (~30 Mev) electron irradiation. These defects are expected to be similar to those produced by high-energy protons. The diagnostic tools used include measurements of galvanomagnetic coefficients, excess carrier lifetime, electron-spin resonance, and infrared absorption. The results indicate that the A center in quartz-crucible-grown silicon is not the primary excess-carrier recombination center. Instead, recombination in quartz-crucible-grown and floating-zone refined silicon appears to be dominated by the same center. This center exhibits a strong dependence of the excess-carrier lifetime on excess-carrier density, with increasing lifetime at higher densities. A variety of other energy levels have been identified by the galvanomagnetic measurements and the rates of introduction of defects have been measured. Author

N66-10655*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Astropower Lab.
INORGANIC SEPARATOR FOR HIGH TEMPERATURE SILVER–ZINC BATTERY Final Report, Jul. 27, 1964–Jul. 29, 1965
Sep. 1965 107 p refs
(Contract NAS3-6007)
(NASA-CR-54749; SM-46220-F) CFSTI: HC $4.00/MF $0.75 CSCL 10C

Silver–zinc test cells using Astroset type 5-036-011 inorganic separators and novel electrode configurations were developed. The cells are capable of long cycle life at both 100° and 25° C. Test cells completed as many as 2286 cycles at 100° and 2704 cycles at 25° C on a half hour discharge one hour charge test schedule at a depth of about 17%. The cells also are capable of operating at 150° and 125° C. Silver–zinc cells built with commercial electrodes and the inorganic separator ran for more than 200 cycles. Voltage performance was comparable to commercial cells at the same current density at 25° C. Gassing characteristics of silver–zinc electrodes were superior to electrodes removed from a commercial cell, and tested with the inorganic separator at both 25° and 100° C. The inorganic separators are capable of more than 2200 cycles at 100° and 25° C at practical drain rates, and can also operate at 125° and 150° C. Paste type silver and paste type zinc electrodes are both capable of as many as 2280 cycles at 100° and 25° C and of operation at 125° and 150° C. However, zinc electrode deterioration occurs after prolonged cycling and at high temperature. R.N.A.

N66-10682*# General Electric Co., Philadelphia, Pa.
SOLAR THERMIONIC FLIGHT EXPERIMENTAL STUDY. VOLUME IV: APPENDICES Final Report
1 May 1965 182 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950852)
(NASA-CR-67816; DOC.-65SD4286, Vol. IV) CFSTI: HC $5.00/MF $1.25 CSCL 10A

Summarized are procedures and nomenclature used in computing: heat transfer and voltage drop in thermionic converter sleeves, cavity energy distribution, generator heat loss, converter heat transfer, radiator design, cesium reservoir design, thermal characteristics of collector-radiator structure, thermal response of cesium reservoir, converter warm-up characteristics, energy changes due to misorientation, generator weight, and concentrator blockage area. Data on the Deep Space Instrumentation Facility tracking system, the STADAN command system, and the Minitrack telemetry system, are also presented. Included are results of an evaluation of generator misalignment and orientation error sensing methods for solar thermionic systems. S.C.W.

N66-10683*# Meteorology Research, Inc., Altadena, Calif.
FURTHER MOISTURE ANALYZER STUDIES Final Report
15 Sep. 1965 29 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950685)
(NASA-CR-67811; MRI65-FR-300) CFSTI: HC $2.00/MF $0.50 CSCL 10C

To improve the sensitivity and response time of a moisture meter, a phosphorus pentoxide cell, based on a thin film concept and fabricated by vacuum deposition techniques, was investigated. Prototype test cells, produced with various combinations of electrode materials, functioned as anticipated at high moisture levels, but demonstrated apparently anomalous behavior at low moisture levels. Life expectancy studies on the tubular cell and the flat plate indicated that closed geometrical configurations could exist in a space environment for prolonged periods, but the exposed flat plate could not. Data on the effects of space pressure environment on P_2O_5 sensor life, and on conduction in thin phosphoric acid films are included. M.G.J.

N66-10701*# Bendix Corp., Southfield, Mich. Research Labs. Div.
FABRICATION AND TEST OF A FLUERIC POSITION SERVO Quarterly Report, 10 Jun.–10 Sep. 1965
[1965] 20 p
(Contract NAS3-6201)
(NASA-CR-54776; BRLD-3133) CFSTI: HC $1.00/MF $0.50 CSCL 13G

In an effort to develop a pneumatic control drum actuator for a nuclear rocket engine in which fluidic devices replace the

electronics, a flueric position servo is being fabricated and tested. The mechanical configuration of the fleuric circuit as well as the breadbox vortex element are discussed and illustrated. A description of the actuation system deals with the load, actuator-motor, power control valve, and fleuric circuit.
M.W.R.

N66-10748*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF LOW-TEMPERATURE DIRECT-CONDENSING VAPOR-CHAMBER FIN AND CONDUCTING FIN RADIATORS
Henry C. Haller, Bruce G. Lindow, and Bruce C. Auer Washington, NASA, Nov. 1965 59 p refs
(NASA-TN-D-3103) CFSTI: HC $3.00/MF $0.50 CSCL 13A

An analytical comparison of flat, direct-condensing finned-tube space radiators using vapor-chamber, double, and central fin-tube geometries was made for a low power output, low temperature Rankine space power electric generating system. Descriptive equations for the radiator investigation included consideration of vapor and liquid headers, pressure drop in headers and radiator tubes, meteoroid protection, and temperature drop in tube armor. Heat transfer, weight, and geometry characteristics of the three radiator fin-tube configurations were determined over a wide range of design variables for a 30-kilowatt powerplant that used steam as the thermodynamic cycle fluid. Thermal degradation of the vapor chamber fin-tube radiator due to fin-segment punctures, and the vapor chamber heat transfer and capillary fluid flow requirements were also investigated. Radiator geometry considerations indicated that, at the minimum weight, the vapor chamber fin-tube radiator had a smaller planform area, fewer radiator tubes, and larger tube inner diameters than the other two fin-tube geometries.
Author

N66-10752*# American Cyanamid Co., Stamford, Conn. Stamford Research Labs.
DEVELOPMENT OF HIGH-PERFORMANCE LIGHTWEIGHT ELECTRODES FOR HYDROGEN-OXYGEN FUEL CELLS First Quarterly Report, Apr. 5–Jul. 5, 1965
W. P. Colman, J. Di Palma, and D. Gershberg 15 Nov. 1965 49 p refs
(Contract NAS3-6477)
(NASA-CR-54759) CFSTI: HC $2.00/MF $0.50 CSCL 10A

Eleven matrix materials were evaluated including one or more forms of asbestos, polytetrafluoroethylene (PTFE)–asbestos, porous PTFE, and zirconia. None of the matrices possesses all the properties required to investigate operating variables at up to 200° C and pressures above atmospheric. However, some were found to be useful over more limited ranges of temperature and pressure. The available matrices make it possible to investigate the effects of operating variables at 100° to 150° C over the entire pressure range of 0 to 60 psig. A statistical design for investigating the variables was revised for the 100° to 150° C range, which permits a mapping of temperature, pressure, and KOH concentration effects. High performance was achieved at 200° C and atmospheric pressure with KOH concentrations of 75 to 80%. Good working voltages were also obtained. This confirms the previous conclusion that cell performance increases with increasing temperature and KOH concentration, and demonstrates the potential performance advantage of operating a matrix fuel cell at temperatures as high as 200° C. In small cell life testing at 100° C, ACCO-I asbestos gave a higher initial voltage and better voltage stability than fuel cell asbestos.
R.N.A.

N66-10804# General Dynamics Corp., Groton, Conn. Electric Boat Div.
THE DESIGN OF AIR CUSHION VEHICLE AUTOMATIC AND SEMI-AUTOMATIC CONTROLS Final Report
Frank J. Hannigan 1 Jul. 1965 101 p refs
(Contract NObs-92050)
(U411-65-032; AD-620144)

The report presents a practical technique for designing automatic and semi-automatic (quickened) control systems for air cushion vehicles (ACV's). These systems have been designed to minimize a major problem in ACV control, vehicular sideslip. General equations of five degrees of freedom of ACV dynamic operation are included from which a mathematical model can be derived; this derivation is also included. The design technique is valid for most vehicle configurations and examples of its application are included for three different control methods. The quickened concept is explained and results of its usage are included. Analog computer data is presented for turning maneuvers at the operating conditions for which the systems were designed as well as at off-design points. From the study that preceded this report it was concluded that an automatic, or a quickened, control system for an ACV offers distinct advantages over conventional manual control, particularly in minimizing sideslip and establishing and maintaining a command heading.
Author (TAB)

N66-10828# Harshaw Chemical Co., Cleveland, Ohio.
RESEARCH ON PHOTOVOLTAIC CELLS Final Technical Documentary Report, 1 May 1962–30 Apr. 1965
Norman E. Heyerdahl and Donald J. Harvey Jun. 1965 122 p refs
(Contract AF 33(657)-7916)
(ARL-65-111; AD-621454)

The report describes research and development on thin film solar batteries. The fabrication and study of thin films of CdS:Se, CdSe, CdTe, ZnSe, and GaAs and thin film solar batteries of CdS:Se, CdSe, and CdTe is discussed in detail. A study of the etching behaviour of II–VI compounds, completed as a part of this program, has been published elsewhere. An abstract of the work is included in this report.
Author (TAB)

N66-10883*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
RADIATION EFFECTS ON SILICON SOLAR CELLS Third Quarterly Progress Report, 1 Jun.–31 Aug. 1964
V. A. J. van Lint and J. Harrity 18 Sep. 1962 25 p refs
(Contract NAS7-91)
(NASA-CR-67607; GADC-3511) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Galvanometric and carrier lifetime measurements were made for studying radiation effects on silicon solar cells. The theoretical rate of defects by high energy electrons in silicon were calculated, and the relation between the carrier removal rate and defect introduction was analyzed. The temperature dependence of the excess carrier lifetimes is discussed; and the results of galvanomagnetic studies of irradiated floating zone refined silicon are presented, along with an analysis of the carrier lifetime in irradiated quartz-crucible grown silicon. The data are depicted graphically.
L.S.

N66-10926*# Clevite Corp., Cleveland, Ohio. Electronic Research Div.
STUDY OF THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER Second Quarterly Report, 1 Jan.–31 Mar. 1963

Warren J. Deshotels, Frank Augustine, and Allan Carlson 5 Apr. 1963 36 p refs
(Contract NAS7-203)
(NASA-CR-67906) CFSTI: HC $2.00/MF $0.50 CSCL 10A

Improvements in processing film samples are described, and data are tabulated to show how the average conversion efficiency has been raised from one-half percent to two percent as more parameters are identified and controlled. The principal cause of this increase is believed to be the cuprous oxide slurry technique. Single crystal cells processed in this manner have exhibited nominal efficiencies as high as nine percent—nearly twice that of crystal cells prepared by the prior electroplating process. Spectral transmission curves are given for evaporated CdS films showing the effect on optical transmission of the barrier layer formed by the cuprous oxide slurry. Other optical measurements are discussed including the transmission and UV behavior of the plastic substrate material, the spectral energy distribution of the solar simulator, and some details of determining the conversion efficiency of solar cells. An experiment is described which shows that the barrier layer accounts for nearly all the electrical resistance ina a CdS cell. Author

N66-10952# British Hydromechanics Research Association, Harlow (England).
A SHORT REVIEW OF PAST RESEARCH INTO THE PROPERTIES OF FLUID JET AMPLIFIERS
R. S. Neve (Borough Polytech.) Feb. 1965 25 p refs
(TN-838) CFSTI: HC $1.00/MF $0.50

Research data on fluid jet devices were reviewed, and the results of the literature survey are summarized. Among the more pertinent findings discussed are the following. Fluid logic elements were developed to perform the logic operations normally carried out electronically, with the binary system's 0 and 1 being represented by a pressure level. Fluid jet devices were also developed to perform analog operations, and the magnitude of a quantity being normally represented by the difference of two momentum outputs. The devices currently used can be grouped under four headings: (1) free jet elements—a power jet was deflected by a control jet or a control pressure; (2) bounded jet elements—deflection was achieved by causing an instability in the wall interaction effect or viscous adhesion; (3) rotational flow effect elements—by causing vorticity in a flow, produced a change of resistance; and (4) turbulence amplifiers—a change of resistance was effected by using a control flow to make a laminar jet change to a turbulent state. The advantages of fluid jet amplifiers over the normal electronic ones became apparent when the system was subjected to excessive temperature or radiation, such as in space. R.W.H.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N66-10129# Oak Ridge National Lab., Tenn.
HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1965
F. L. Parker et al Oct. 1965 274 p refs
(Contract W-7405-ENG-26
(ORNL-3849)

Continued research in the following areas is reported: radioactive waste disposal, radiation ecology, radiation physics, internal dosimetry, radiation dosimetry, and health physics technology. Cited are studies of: disposal by hydraulic fracturing, the movement of nuclides in terrestrial environments, radiation effects and radioactive waste areas, theoretical and systems ecology, the interaction of radiation with solids, the physics of tissue damage, dosimetry applications, stable element metabolism, aerosol physics, and applied internal dosimetry. S.C.W.

N66-10160# Chicago Univ., Ill. Radiation Lab.
[RESEARCH ON CERTAIN BIOLOGICAL AND MEDICAL ASPECTS OF ATOMIC ENERGY] Quarterly Progress Report
15 Apr. 1965 105 p refs
(Contract AF 41(609)-1693)
(QPR-55; AD-615174)

CONTENTS:

1. THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. I: STUDIES ON THE TOXICITY AND MECHANISM OF ACTION OF 2-MERCAPTOETHYLAMINE (MEA) K.-M. Yam and K. P. Du Bois p 1–16 refs (See N66-10161 01-04)

2. THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. II: FURTHER STUDIES ON THE INHIBITORY EFFECT OF X-RADIATION ON THE DEVELOPMENT OF MICROSOMAL ENZYMES OF THE LIVER F. Kinoshita and K. P. Du Bois p 17–28 refs (See N66-10162 01-04)

3. THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. III: FURTHER STUDIES ON THE ADENOSINE TRIPHOSPHATASE ACTIVITY OF THE HEMATOPOIETIC TISSUES OF RATS EXPOSED TO COBALT-60 GAMMA RADIATION R. Tardiff and K. P. Du Bois p 29–36 refs (See N66-10163 01-04)

4. PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. I: DOSE-MORTALITY RELATIONSHIPS FOR SEVERAL RADIOPROTECTIVE AGENTS V. Plzak and J. Doull p 37–70 refs (See N66-10164 01-04)

5. PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. II: MICROSCOPIC FINDINGS IN THE SPLEENS OF MICE GIVEN DIMETHYL SULFOXIDE OR OTHER CHEMICAL RADIOPROTECTIVE AGENTS PRIOR TO LETHAL WHOLE-BODY X-RAY EXPOSURE D. Vesselinovitch, E. L. Simmons, F. Fitch, and J. Doull p 71–81 refs (See N66-10165 01-04)

6. PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. III: RELATIONSHIP BETWEEN SPLEEN OXYGEN TENSION AND RADIOPROTECTION WITH p-AMINOPROPIOPHENONE (PAPP) IN MICE A. T. Hasegawa and H. D. Landahl p 82–87 refs (See N66-10166 01-04)

7. THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. I: HYPERBARIC OXYGEN EXPOSURE AND RADIATION MORTALITY IN ANIMALS J. Doull, E. L. Simmons, E. L. Marks, and V. J. Plzak p 88–102 refs (See N66-10167 01-04)

N66-10161 Chicago Univ., Ill. Radiation Lab.
THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. I: STUDIES ON THE TOXICITY AND MECHANISM OF ACTION OF 2-MERCAPTOETHYLAMINE (MEA)

Kei-ming Yam and Kenneth P. Du Bois *In its* [Res. on Certain Biol. and Med. Aspects of Atomic Energy] 15 Apr. 1965 p 1–16 refs (See N66-10160 01-04)

Continued efforts were made to reduce the acute toxicity of MEA to adult female rats by using various chemical compounds. In the experiments described, none of the agents tested was capable of completely abolishing the central nervous system excitation produced by MEA. Signs of central nervous system excitation persisted, and they ranged from jerking movements of the extremities, erection of the tail, and mild convulsive movements to tonic-clonic convulsions. It is pointed out that agents effective in counteracting the acute lethal effect of MEA, like pentobarbital, chlorpromazine, reserpine, and magnesium sulfate are compounds having central nervous system depressant and peripheral neuromuscular relaxation effects; and this suggests that counteracting the asphyxiant effect of the convulsions produced by MEA is the most effective measure in the control of the acute toxicity of MEA. R.R.D.

N66-10162 Chicago Univ., Ill. Radiation Lab.
THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. II: FURTHER STUDIES ON THE INHIBITORY EFFECT OF X-RADIATION ON THE DEVELOPMENT OF MICROSOMAL ENZYMES OF THE LIVER

Florence Kinoshita and Kenneth P. Du Bois *In its* [Res. on Certain Biol. and Med. Aspects of Atomic Energy] 15 Apr. 1965 p 17–28 refs (See N66-10160 01-04)

Experiments were continued to elucidate the mechanism by which irradiation inhibits enzyme synthesis. Specifically, the effect of radiation on O-demethylase activity was examined and it was found that this system is not affected by radiation. Although this enzyme is developed to the adult level by 23 days of age, there is no sex difference in its activity; however, those enzymes whose development is inhibited by radiation reach the adult level around 35 to 50 days of age and exhibit a sex difference in activity. It is therefore concluded that radiation inhibits the system responsible for the synthesis of increased activity of some enzymes in the livers of male rats. Since castration of male rats prevents development of the same enzymes and certain androgens stimulate enzyme synthesis, it is further shown that the point of action of radiation is on the androgen-stimulated enzyme synthesis process. R.R.D.

N66-10163 Chicago Univ., Ill. Radiation Lab.
THE EFFECT OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. III: FURTHER STUDIES ON THE ADENOSINE TRIPHOSPHATASE ACTIVITY OF THE HEMATOPOIETIC TISSUES OF RATS EXPOSED TO COBALT-60 GAMMA RADIATION

Robert Tardiff and Kenneth Du Bois *In its* [Res. on Certain Biol. and Med. Aspects of Atomic Energy] 15 Apr. 1965 p 29–36 refs (See N66-10160 01-04)

Adult, female Sprague-Dawley rats were exposed to 21.2 R and 51 R per day of cobalt 60 gamma irradiation over a 10-hour period for various lengths of time. After various total doses of radiation, the animals were sacrificed for adenosine triphosphatase measurements on the spleens and thymus glands. In adult animals, the adenosine triphosphatase activity of the thymus glands showed no appreciable increase after repeated exposure to gamma radiation; however, the enzyme activity of the thymus glands of weanling rats increased after repeated doses of gamma radiation. R.R.D.

N66-10164 Chicago Univ., Ill. Radiation Lab.
PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. I: DOSE-MORTALITY RELATIONSHIPS FOR SEVERAL RADIOPROTECTIVE AGENTS

V. Plzak and J. Doull *In its* [Res. on Certain Biol. and Med. Aspects of Atomic Energy] 15 Apr. 1965 p 37–70 refs (See N66-10160 01-04)

Dose reduction factors (DRF) for eight radioprotective agents and six salts of aminoethylisothiourea were determined in male mice, using a computer programed maximum likelihood estimate procedure based on the 30-day mortality data following whole-body X-ray exposures in the range of 400 R through 900 R. A listing of the DRF values for 50 of the most effective radioprotective agents tested in the radiation screening program is presented in tabular form. R.R.D.

N66-10165 Chicago Univ., Ill. Radiation Lab.
PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. III: MICROSCOPIC FINDINGS IN THE SPLEENS OF MICE GIVEN DIMETHYL SULFOXIDE OR OTHER CHEMICAL RADIOPROTECTIVE AGENTS PRIOR TO LETHAL WHOLE-BODY X-RAY EXPOSURE

D. Vesselinovitch, E. L. Simmons, F. Fitch, and J. Doull *In its* [Res. on Certain Biol. and Med. Aspects of Atomic Energy] 15 Apr. 1965 p 71–81 refs (See N66-10160 01-04)

The effect of dimethylsulfoxide (DMSO) on the gross and microscopic changes produced in the spleen of female mice by whole-body X-ray exposure (800 R) were compared with those produced by aminoethylisothiouronium (AET) and p-aminopropiophenone (PAPP). Although DMSO exhibited radioprotective activity in the hematopoietic system in terms of recovery of the spleen weight and colony formation, these effects were less marked than those produced by the administration of either AET or PAPP. Regeneration of the hematopoietic elements in the radiation damaged spleen was qualitatively similar following the administration of DMSO, AET, and PAPP except for a more pronounced recovery of the myelopoietic series in the PAPP-treated mice. R.R.D.

N66-10166 Chicago Univ., Ill. Radiation Lab.
PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. III: RELATIONSHIP BETWEEN SPLEEN OXYGEN TENSION AND RADIOPROTECTION WITH p-AMINOPROPIOPHENONE (PAPP) IN MICE

A. T. Hasegawa and H. D. Landahl *In its* [Res. on Certain Biol. and Med. Aspects of Atomic Energy] 15 Apr. 1965 p 82–87 refs (See N66-10160 01-04)

Measurements were made of oxygen tension in the spleen and protection against radiation lethality following the administration of p-aminopropiophenone (PAPP) in mice. Experiments showed that the relative oxygen tension in the spleen of mice was 0.74, 0.35, and 0.49 of normal at 4, 15, and 60 minutes after PAPP injection. In propylene glycol treated mice, the oxygen tension values were 0.96, 1.02, and 1.78 at the corresponding times. R.R.D.

N66-10167 Chicago Univ., Ill. Radiation Lab.
THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. I: HYPERBARIC OXYGEN EXPOSURE AND RADIATION MORTALITY IN ANIMALS
J. Doull, E. L. Simmons, E. L. Marks, and V. J. Plzak *In its* [Res. on Certain Biol. and Med. Aspects of Atomic Energy] 15 Apr. 1965 p 88–102 refs (See N66-10160 01-04)

The ability of mice, rats, and rabbits to withstand chronic hyperbaric oxygen exposure was investigated by using various cycling schedules of alternate oxygen and air exposure. It was found that the chronic exposure of male and female mice to hyperbaric oxygen in a cycle consisting of 1 hour of oxygen at 15 psig followed by 15 minutes of air at 0 psig (repeated 19 times daily) produced a mortality of between 80% and 100% during a 30-day exposure period. Reducing the oxygen pressure to 10 psig permitted male and female mice, Sprague-Dawley rats, and a rabbit to survive an exposure period of 30 days. New-born and weanling mice appeared to be less susceptible to the effects of chronic hyperbaric oxygen exposure than adult animals of the same strain. Hyperoxia in the range of 20% through 84% oxygen during whole-body X-ray exposure did not markedly alter the lethal effects of X-ray doses of 40 R, 500 R, or 600 R. Subjecting mice to increased air pressure (15, 30, or 45 psig) during whole-body X-ray exposure also failed to markedly influence the mortality response of similar X-ray doses. R.R.D.

N66-10190# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.
HEALTH PHYSICS AND MEDICAL DIVISION PROGRESS REPORT, JANUARY–DECEMBER, 1964
London, HMSO, Mar. 1965 39 p refs
(AERE-PR/HPM-7(U)) HMSO: 8s

In response to the operational requirements of the Atomic Energy Authority, research is continuing in radiation dosimetry, aerosol physics, radiation spectrometry, bioassay, body radioactivity measurement, and biomedical problems. Among the reports included are findings on inhalation studies with human volunteers using radioactive vapors and labelled submicron aerosols; methods of producing nonleaching monodisperse aerosols; experiments with volunteers to investigate the uptake, transport, and distribution of radioactive methyl iodide; whole-body neutron activation analysis of the natural sodium, chlorine, and calcium contents of two volunteer subjects; behavior and control of radioiodine released in a water-cooled reactor accident; personnel dosimetry development; and computer analysis of gamma ray spectra. M.G.J.

N66-10192# United Kingdom Atomic Energy Authority, Harwell (England). Electronics Div.
NEW METHODS OF MEASURING NEUTRON DOSE EQUIVALENT RATE AROUND PULSED NEUTRON GENERATORS
J. W. Leake London, HMSO, Jun. 1965 21 p refs
(AERE-R-4883) HMSO: 3s

Two methods of measuring neutron dose equivalent (DE) around pulsed machines are described. Both methods employ the moderator system of the neutron counter assembly with either the standard boron trifluoride pulse counter or a BF_3 ion chamber mounted at the center. The limitations of the neutron counter assembly with the pulse-type counter and the advantages of the ion chamber version are discussed. It is shown that under favorable conditions the neutron counter assembly with a pulse-type counter is able to moasure pulsed radiation, with less than 2% count loss, up to a mean DE rate of 1 rem/hr. The response of both systems is proportional to DE rate (as recommended by the I.C.R.P. 1963) within ±50% for neutrons of all energies from thermal to 12 MeV. Author

N66-10199# Joint Publications Research Service, Washington, D. C.
STUDIES ON AIR POLLUTION AND INDUSTRIAL POISONING IN THE USSR
26 Oct. 1965 26 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), no. 5, 1965 p 15–20, 110–112, 114–115
(JPRS-32565; TT-65-33044) CFSTI: $2.00

CONTENTS:

1. EFFECT OF SMALL CONCENTRATIONS OF HEXAMETHYLENEDIAMINE ON EXPERIMENTAL ANIMALS UNDER CONDITIONS OF CHRONIC INHALATION p 1–12 refs
2. TWO CONFERENCES ON THE SANITARY PROTECTION OF THE ATMOSPHERIC AIR D. H. Kalyuzhnyy p 13–18
3. CONFERENCE OF YOUNG SCIENTIFIC WORKERS IN THE INSTITUTE OF INDUSTRIAL HYGIENE AND OCCUPATIONAL DISEASES OF THE ACADEMY OF MEDICAL SCIENCES OF THE USSR V. I. Mogilyantseva p 19–24

N66-10201# Joint Publications Research Service, Washington, D. C.
SOME NEW TECHNIQUES IN PHYSIOLOGY
V. V. Parin 27 Oct. 1965 4 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 9 Sep. 1965 p 6
(JPRS-32585; TT-65-33064) CFSTI: $1.00

Electronic methods have permitted physiologists to increase the sensitivity of their devices and to study slow and rapid bioelectric phenomena. Data were obtained when a subject was in motion, without the use of wires. A low-power miniature transmitting device was mounted in his helmet, pocket, or special knapsack while he was engaged in athletic exercise. A study of higher nervous activity was transmitted to the surface of the skin without wire connections. This permitted an investigation of the activity of an animal at any time during ordinary conditions of life. Experiments were also performed by recording some physiological processes of animals kept in a pasture. R.W.H.

N66-10203# Joint Publications Research Service, Washington, D. C.
BIOLOGIC MEMORY AND NUCLEIC ACIDS
V. L. Ryzhkov 5 Oct. 1965 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 4, Jul.–Aug. 1965 p 533–541
(JPRS-32266; TT-65-32756) CFSTI: $1.00

Memory theories were considered in which a memorization process was changed in the sequence of the nucleotide composition of RNA, reducing it to a process similar to mutations. The basis of memorization in the spiralization of individual secretions of the DNA filament resulted in the inactivation of these secretions. It was stated that spiralization caused a shift in the ratio between the potassium and sodium ions under the influence of nervous stimulation. A hypothesis was proposed based on the indirect experimental data of giant chromosomes, which reduced memory to simple and general processes (spiralization of the chromosomes observed in the cycles of development of the cell and microorganisms). R.W.H.

N66-10316*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography With Indexes, Sep. 1965
Oct. 1965 132 p
(NASA-SP-7011(16)) CFSTI: HC $1.00/MF $1.00 CSCL 06S

An annotated bibliography of aerospace medicine and biology is presented, along with subject, corporate source, and

personal author indices. Subject coverage concentrates on the biological, physiological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Related topics such as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, and exobiology are also given attention. L.S.

N66-10438# Technische Hogeschool, Eindhoven (Netherlands).
RECEPTIVE SYSTEMS. MEDIATING CERTAIN LIGHT REACTIONS OF THE PUPIL OF THE HUMAN EYE
Herman Bouma (Ph.D. Thesis) 19 Jan. 1965 185 p refs
CFSTI: HC $5.00/MF $1.25

An analysis is made of the receptive systems for both steady state and flash reactions of the pupil with regard to receptor properties and the organization of the receptive field. A general description of the pupillary system is presented and includes anatomical and physiological data, pupillary reactions and their consequences, passive mechanical properties of iris tissue, and the innervation of iris muscle. Steady-state reactions, transient reactions, and fluctuations of the pupil in response to retinal illumination are discussed. Various methods for measuring steady-state diameters and contractions of the pupil in response to flashes are discussed. R.N.A.

N66-10441# Societa Ricerche Impianti Nucleari, Saluggia (Italy).
ELECTROCHEMICAL LABELLING OF PROTEINS [MARCATURA DI PROTEINE PER VIA ELETTROCHIMICA]
U. Rosa, F. Pennisi, A. Massaglia, G. Scassellati, L. Donato (Pisa Univ.) et al Aug. 1965 50 p refs In ITALIAN
(Contract EURATOM-053-63-10-RISI)
(EUR-2476.i) CFSTI: HC $2.00/MF $0.50

This report is part of a research program on the iodination of proteins for use as tracers in studies on protein metabolism. With the aid of an electrolytic labelling method, studies were conducted on the preparation of radioiodide labelled human serum, albumin, and insulin. Data are given on the apparatus used and the techniques employed for the preparation and control of the end product. The effects of iodination on the protein molecule were studied on the basis of the physicochemical and biological properties. A preliminary study was made to determine the chemical effects as a function of the degree of iodination. The —SH groups in albumin and S–S groups in insulin were titrated amperometrically. The distribution of the iodine in the residual tyrosine was studied by means of MIT and DIT in the hydrolysate. The first batch of results obtained from the project are described and discussed. R.N.A.

N66-10477# Chicago Univ., Ill.
STUDY OF MONKEY, APE, AND HUMAN MORPHOLOGY AND PHYSIOLOGY RELATING TO STRENGTH AND ENDURANCE. PHASE VII: THE MUSCULOSKELETAL ANATOMY OF THE ANTEBRACHIUM OF A SQUIRREL MONKEY (*SAIMIRI*)
William E. Edwards and Erika Fogg-Amed Holloman AFB, N. Mex., 6571st Aeromed. Res. Lab., Jul. 1965 46 p refs
(Contract AF 29(600)-3466)
(ARL-TR-65-9; AD-468248)

The antebrachial musculature of a female squirrel monkey (Saimiri) is quantitatively described in detail and illustrated by the photo-etching process. Comparisons with data from the literature on other platyrrhines and non-playtyrrhine primates indicate marked taxonomic distinctiveness and primitivity in many features. Author (TAB)

N66-10478# Chicago Univ., Ill.
STUDY OF MONKEY, APE, AND HUMAN MORPHOLOGY AND PHYSIOLOGY RELATING TO STRENGTH AND ENDURANCE. PHASE VIII: FACTORS IN THE SUPERIORITY OF CHIMPANZEE OVER HUMAN STRENGTH
William E. Edwards Holloman AFB, N. Mex., 6571st Aeromed. Res. Lab., Jul. 1965 46 p refs
(Contract AF 29(600)-3466)
(ARL-TR-65-10; AD-468249)

Detailed consideration and testing of hypotheses against available data indicate that the marked two-to-one superiority of chimpanzee over human upper extremity strength per unit of body-weight is apparently due to a combination in the chimpanzee of relatively larger upper extremities, higher proportions of contractile material, smaller average body-size, muscle origins and insertions farther from joints, obliquity of muscle fibers, greater capillary density and glycogen storage in muscles, and greater frequency and ease of innervating a higher percentage of motor end-plates, but not so different physico-chemical processes of muscular contraction and not, among the subjects tested, significantly to difference in exercise, although somewhat differential response to equivalent exercise is likely. Author (TAB)

N66-10496# United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch.
COMPARATIVE REVIEW OF THE PRINCIPAL NON-STATUTORY UNITED KINGDOM CODES OF PRACTICE FOR PROTECTION AGAINST IONISING RADIATIONS AND RADIOACTIVE MATERIALS
E. J. Bennellick Jul. 1965 29 p refs
(AHSB-(RP)-M-35)

A comparison is made of the main provisions of five Codes of Practice comprising two issued by the United Kingdom Atomic Energy Authority and one each by the Medical Research Council, the Ministry of Health and the Ministry of Labour. Author

N66-10499# Joint Publications Research Service, Washington, D. C.
THE EFFECT OF COSMIC-FLIGHT FACTORS ON SEEDS OF THE SPINDLE-TREE (*EUONYMUS EUROPAEA* L.)
N. I. Nuzhoin, R. L. Dozortseva, N. A. Pastushenko-Strelets, and N. S. Samokhvalova 5 Oct. 1965 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 4, Jul.–Aug. 1965 p 576–580
(JPRS-32265; TT-65-32755) CFSTI: $1.00

Previously irradiated air-dry seeds of the European spindle-tree, *Euonymus europaea*, and unirradiated control seeds were flown on Vostok V spacecraft during a cosmic flight. Also, control seeds of the same plant were kept in Moscow and flown to the cosmodrome. The frequency of the cells with chromosome aberrations was studied. In a series without previous irradiation of the seeds with gamma radiation the frequency of the cells with abnormal mitoses differed from both controls in a statistical manner. In a series in which the seeds were irradiated before cosmic flight with Co^{60} the differences were statistically reliable only as between the experiment and the control retained in Moscow. Previous irradiation of the seeds with Co^{60} gamma radiation and the subsequent action of cosmic flight have an additive effect in the formation of cells with abnormal mitoses. E.E.B.

N66-10517# Joint Publications Research Service, Washington, D. C.

ACCLIMATIZATION AND TRAINING OF ATHLETES IN A MOUNTAINOUS AREA

A. D. Bernshteyn, ed et al Oct. 1965 182 p Transl. into ENGLISH of the book "Akklimatizatsiya i Trenirovka Sportsmenov v Gornoy Mestnosti" USSR, ALMA-ATA, 1965 143 p (JPRS-32290; TT-65-32780) CFSTI: $5.00

Among the data presented are a series of articles on: some physiological indices of visiting sportsmen under conditions of a foothill area; the vegetative mechanisms of high mountain adaptation and their role in increasing the hypoxia resistance of the body; the effect of the middle mountain area of Tien Shan on the higher nervous activity of athletes; problems of acclimatization to altitude; change of the osmotic resistance of erythrocytes in people and animals during the period of acclimatization to a high mountain area; training for hypoxia as a means of increasing working ability; aspects of the reaction of physiological functions in people performing physical labor during a period of acclimatization to the high mountain area of Tien Shan; phagocyte and enzyme activity, ribonucleic acid content, and certain indices of the hormonal system upon physical loading under conditions of hypoxia; and changes of certain indices of external respiration during the initial period of acclimatization to a high mountainous area in people depending on the age and degree of training. R.W.H.

N66-10518# Joint Publications Research Service, Washington, D. C.

ULTRASOUND IN MOLECULAR BIOLOGY

I. Ye. El'piner 25 Oct. 1965 17 p Transl. into ENGLISH from Priroda (Moscow), no. 8, 1965 p 20–27 (JPRS-32532; TT-65-33011) CFSTI: $1.00

The investigation of physical phenomena originating upon the propagation of ultrasound vibrations of high intensity within a fluid is considered. The propagation of ultrasound waves was realized via periodic compression and rarefaction of the medium. Cavitation took place at the borderline of the fluid-solid body or on the surface of poorly moistened hard particles which were suspended on a medium. It was shown that a certain admixture (initiators), in case of their dissociation within the cavitation bubble with the formation of atoms or radicals, may ensure the origin of chain reactions under the effect of the ultrasound waves. It was stated that by using ultrasound waves the synthesis of biologically active substances was possible; it was possible to induce controlled chemical transformations of these substances and to form a number of molecules with modified biological activity. The controlled physicochemical changes were also detected as a result of the effect of ultrasound waves on biomacromolecules, proteins, and nucleic acids. R.W.H.

N66-10559# Joint Publications Research Service, Washington, D. C.

LIFE IN THE LIGHT OF MODERN ACHIEVEMENTS OF BIOLOGICAL SCIENCES

A. I. Korotyayev 19 Oct. 1965 16 p refs Transl. into ENGLISH from Vopr. Filosofii (Moscow), no. 8, 1965, p 116–125 (JPRS-32457; TT-65-32936) CFSTI: $1.00

A philosophical discussion is presented on the concept of life, its essence, and origin. The following questions are briefly analyzed: (1) What is the essence of life in the light of the modern data of the biological sciences? (2) What is the basic difference between non-living and living matter? (3) What does modern biology offer that is new on the question of the origin of life on Earth? Various writings on this subject are reviewed. E.E.B.

N66-10564# School of Aerospace Medicine, Brooks AFB, Tex.

SOME STRUCTURAL REQUIREMENTS OF NITROGENEOUS SUBSTANCES WHICH HAVE PROTECTIVE EFFECTS AGAINST ACUTE HYDRAZINE TOXICITY IN MICE Technical Report, Jul.–Nov. 1964

Eugene Roberts, Daisy G. Simonsen, and Ethel Roberts May 1965 11 p refs

(SAM-TR-65-10; AD-469678)

A continuation of previous studies on the protective effects of various substances against acute hydrazine toxicity in mice has revealed several interesting structural features. These are consistent with the provisional interpretation that the protective substances may compete with hydrazine for a site or sites on cell membranes (neuronal, hepatic, or both). At present, it appears likely that the protective actions of L-arginine and L-ornithine can be attributable only in part to their roles in ammonia detoxication via urea biosynthesis in liver. It also appears that the protection against lethality which they afford also may have a physical basis in terms of membrane interactions. Author (TAB)

N66-10565# School of Aerospace Medicine, Brooks AFB, Tex.

EFFECTS OF IONIZING RADIATION ON ENOLASE. INACTIVATION AND CHEMICAL PROTECTION Technical Report, 1 Sep.–31 Dec. 1964

Jack A. Winstead, Arthur E. Gass, Jr., and John P. Higdon Jul. 1965 9 p refs

(SAM-TR-65-20; AD-470850)

Rabbit-muscle enolase in aqueous solutions was inhibited by gamma irradiation. An exponential inactivation was observed. The G values increased with increasing protein concentration with a value of 0.21 for a 2.5×10 to the -5 M enolase solution. Both sulfhydryl and nonsulfhydryl compounds were shown to be effective in protecting enolase against gamma radiation. Imidazole and analogs were found to be a very effective group of protective agents. It was postulated that the protective effects observed on this enzyme system were due to the mechanism of radical scavenging. Author (TAB)

N66-10566# School of Aerospace Medicine, Brooks AFB, Tex.

EFFECT OF OBSERVER ELEVATION ON THE MOON ILLUSION Technical Report 1 Jun. 1963–1 Jun. 1964

James E. Hamilton Jun. 1965 15 p refs

(SAM-TR-65-46; AD-470897)

A study was made to determine if an increase in elevation of an observer above terrain causes a change in the magnitude of the moon illusion and estimation of distance upon the terrain. A comparison was made to determine a relationship between the magnitude of the illusion at different observer elevations and the correponding estimation of distance. It was found that a general decrease in the magnitude of the moon illusion coincides with a general increase in estimated distance when an observer ascends from a point above a terrain. Evidence is lacking to support the apparent-distance theory when an observer ascents above a terrain. Author (TAB)

N66-10567# School of Aerospace Medicine, Brooks AFB, Tex.

ENDOCRINE AND METABOLIC CHANGES DURING A 12-HOUR SIMULATED FLIGHT

Henry B. Hale, James P. Ellis, Jr., and Edgar W. Williams Jun. 1965 10 p refs

(SAM-TR-65-35; AD-469685)

Forty-eight young men were studied by means of serial urinary determinations while working in flight simulators for 12

hours. The flights began at 0700 hours and ended at 1900 hours. Postflight values obtained at 2100 hours were compared with control values obtained at 2100 hours on the day before the test. Creatinine excretion did not show statistically significant variation with time. All other urinary constituents were expressed as ratios with creatinine. Simulated flight induced statistically significant elevations in urine volume, urea, uric acid, phosphorus, sodium, the Na/K ratio, 17-hydroxycorticosteroids, epinephrine, and norepinephrine. The NE/E ratio fell significantly. Author (TAB)

N66-10568# School of Aerospace Medicine, Brooks AFB, Tex.
EXPERIMENTAL DECOMPRESSION SICKNESS FROM HYPERBARIC NITROUS OXIDE ANESTHESIA
Robert G. Mc Iver, William P. Fife, and Kenneth G. Ikels Jun. 1965 16 p 18 p refs
(SAM-TR-65-47; AD-470657)

Nitrous oxide-oxygen mixtures were administered to dogs at 3, 4, and 5 atmospheres absolute pressure for 30 minutes. Animals which breathed mixtures containing 1,824 mm. Hg. or more, partial pressure of N_2O showed respiratory depression to the point of apnea in some instances. The animals in this group which did not expire from respiratory arrest developed fatal nitrous oxide decompression sickness upon decompression. Author (TAB)

N66-10569# School of Aerospace Medicine, Brooks AFB, Tex.
SOME NOTES ON THE THRESHOLD OF THE VESTIBULAR CORIOLIS EFFECT AND ITS SIGNIFICANCE TO AIRCREW
Technical Report, 1 Oct. 1964–1 Feb. 1965
Kent K. Gillingham Aug. 1965 8 p refs
(SAM-TR-65-55; AD-472167)

By employing self-induced Coriolis stimulation, subjects are able to perceive otherwise undetectable constant angular velocity in the yaw plane. How accurately this can be done is studied by determining the psychophysical functions for the discrimination of direction of rotation of different yaw velocities. The results indicate that perceivable Coriolis effects can be generated by constant angular velocities of less than 1 degree/sec. This means that: (1) spatial disorientation due to the Coriolis effect can occur at very slow turn rates in instrument flying, and (2) that pilots' head-shaking maneuvers may be an appropriate means of countering some forms of spatial disorientation. Author (TAB)

N66-10579# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
FACTORS INFLUENCING THE RENAL REGULATION OF CALCIUM—IMPLICATIONS OF PROLONGED WEIGHTLESSNESS
William C. Nungesser May 1965 29 p refs *Its* Rev. 2-65

The metabolism of calcium is reviewed with special emphasis on methods of laboratory determination, general metabolism, and calcium regulation. The renal handling of calcium is emphasized. There is a discussion of the factors leading to the precipitation of kidney stones. The author takes the view that it is unlikely that kidney stones will be a problem in prolonged space flight. However, he makes several recommendations for the keeping of these problems to the irreducible minimum. The review is accompanied by a table showing the physical-chemical factors of input-output as they relate to the physical solubility of calcium salts in kidney stones. The author concludes that the whole area of calcium and magnesium balance under loading conditions, the relationship of parathyroid and calcitonin, and the factors affecting gastrointestinal absorption. The review is intended to study in depth the factors influencing the handling of calcium by the kidneys, including any implications of prolonged weightlessness. Author (TAB)

N66-10586# Joint Publications Research Service, Washington, D. C.
RECENT STUDIES ON INDUSTRIAL TOXICOLOGY IN THE USSR
B. Yu. Kalimin, E. H. Komorova, and B. A. Kurlyandskii 19 Oct. 1965 13 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), v. 30, no. 6, 1965 p 65–67, 73–76
(JPRS-32451; TT-65-32930) CFSTI: $1.00

CONTENTS:

1. APPARATUS FOR THE STUDY OF TOXIC PROPERTIES OF VOLATILE PRODUCTS FROM PLASTICS B. Yu. Kalimin and E. H. Komorova p 1–5 ref
2. ORGANIZATION AND WORK OF THE TOXICOLOGICAL LABORATORY AT THE MOSCOW SANITARY-EDIMIOLOGICAL STATION B. A. Kurlyandskii p 6–11

N66-10594# Turin Univ. (Italy). Medical Clinic.
BEHAVIOUR OF DNA SYNTHESIS IN DIFFERENT PHASES OF THE S-PERIOD IN CHROMOSOMES OF HUMAN ACUTE LEUKAEMIA
F. Gavosto, L. Pegoraro, A. Pileri, and R. Bernardelli Brussels, EURATOM, Aug. 1965 10 p refs Presented at the 10th Congr. of the Intern. Soc. of Haematol., Stockholm, 30 Aug.–4 4 Sep. 1964
(Contract EURATOM-016-62-1 BIOI)
(EUR-2451.e) CFSTI: HC $1.00/MF $0.50

A previously reported in vivo technique was improved in order to investigate the behavior of DNA synthesis at chromosome level in different stages of the S-period in human acute leukemia cells. After intravenous injection of tritiated thymidine, bone marrow samples were withdrawn at different intervals. The incorporation of thymidine was determined within the chromosomes and their segments of c-mitoses of cells which at the moment of labelling were in the early, intermediate and final stage of the S-period. Comparative analysis of the incorporation values in the single chromosomes and in the different stages of the synthetic period was performed. Asynchronism of DNA synthesis was evaluated through the whole S-period, and it was shown to be more evident in the terminal stage as compared to the early phase. Author

N66-10736# Royal Canadian Air Force, Toronto (Ontario). Inst. of Aviation Medicine.
THE EFFECT OF ACCELERATION ON THE DISTRIBUTION OF PULMONARY BLOOD FLOW
A. C. Bryan and W. D. Mac Namara Nov. 1964 14 p refs
(Rept.-64-RD-8; AD-467516)

The distribution of pulmonary blood flow has been measured during increased positive (+Gz) acceleration. Macroaggregatad albumin labelled with Iodine^{131} was injected intravenously during centrifugal acceleration. The particles embolize the pulmonary vascular bed in proportion to flow and can be subsequently detected by scintillation scanning of the lung. Studies were done supine, seated and at +2, +3 and +4Gz. The results show a progressively smaller reduction in upper zone perfusion with increasing acceleration agreeing with hydrostatic principles. Flow increases in the base up to +2Gz but thereafter becomes fixed, suggesting that the vessels are then maximally dilated. The gas exchange consequences of these changes of perfusion are discussed indicating that there must also be ventilatory changes. Author (TAB)

N66-10773*# Oregon State Univ., Corvallis.
MICROORGANISM STUDY Progress Report
W. B. Bollen Pasadena, Calif., JPL, 20 Aug. 1965 53 p Prepared for JPL
(Contracts NAS7-100; JPL-950783)
(NASA-CR-67686) CFSTI: HC $3.00/MF $0.50 CSCL 06M

Descriptive charts for 12 more isolants are presented. All 12 are soil diphtheroids. The only available genus for these is *Corynebacterium* into which they fall readily with respect to morphology and general physiology. However, many of their biochemical reactions and cultural characters, especially pigmentation, are different. They undoubtedly constitute a part of Winogradsky's unclassified autochthonous microflora and a new genus should be established for them. Cultural characteristics of these bacterial colonies and photomicrographs are included. R.N.A.

N66-10848# School of Aerospace Medicine, Brooks AFB, Tex.
THE EFFECT OF EXPOSING STANNOUS FLUORIDE-TREATED ENAMEL SURFACES TO WHOLE SALIVA
Ira L. Shannon Jul. 1965 11 p refs
(SAM-TR-65-28; AD-469637)

Three experiments were carried out in which the effect of whole saliva on the ability of stannous fluoride to protect enamel surfaces was studied. When stannous fluoride-treated enamel was exposed to whole saliva for 24 hours, the protective efficacy of the stannous fluoride treatment dropped from 72.4% to 27.0%. No further drop was seen over an additional 72 hours. Dipping stannous fluoride-treated teeth into whole saliva for only a few seconds significantly decreased the protection afforded the enamel by the treatment. This rapid loss in effectiveness was believed to be caused by chemical reactions between the hydrated stannous oxide layer on the tooth surface and the ions of saliva. Two-thirds of the protection provided enamel surfaces by the topical application of stannous fluoride proved temporary in nature. This emphasized the importance of very frequent reinforcement by daily applications of a compatible stannous fluoride preparation. Thus, the premise was strengthened that there is promise in a properly managed, caries-prevention program that utilizes a low-concentration stannous fluoride mouthwash. Author (TAB)

N66-10849# School of Aerospace Medicine, Brooks AFB, Tex.
WATER AND SOLUTE SHIFTS BETWEEN THE BLOOD AND INTRAPERITONEAL GLUCOSE INFUSATE
Albert E. New and Alfonso Zermeno May 1965 18 p refs
(SAM-TR-65-5; AD-469627)

An isosmotic glucose solution was injected into the peritoneal cavity of 21 anesthetized dogs and the exchanges of solutes and water were determined for plasma and peritoneal fluid. Little change in the peritoneal fluid volume occurred during the first 45 minutes. Glucose rapidly diffused out of the cavity and an influx of sodium, chloride, potassium, and urea resulted. After this period, water diffused into the cavity, glucose continued to leave, and the influx of plasma ions and urea persisted. Reabsorption began after 3 hours when an equilibrium was reached. The packed cell volume of all animals increased. There was evidence that little or no urine was produced during the course of the experiments. A method for calculating quantitative solute fluxes, by employing a compartmental model system based on a simple analytic procedure, is illustrated. From this model, flow-rate constants were obtained which describe fixed characteristics of the peritoneal membrane. Author (TAB)

N66-10905# Stanford Research Inst., Menlo Park, Calif.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS IN TRAINABLE PATTERN-CLASSIFYING SYSTEMS Final Report, Jun. 1964–Jun. 1965
Nils J. Nilsson Griffiss AFB, N. Y., RADC, Sep. 1965 111 p refs
(Contract AF 30(602)-3448)
(RADC-TR-65-257; AD-471810)

Motivation is given for the use of various trainable pattern-classifying structures called *linear* and *piecewise linear (PWL)* machines. The results of various experiments in training these machines are presented. Two different types of training methods were investigated: mode-seeking and error-correction methods. These methods are illustrated by experiments using two-dimensional patterns so that the results of training can be easily visualized. More thorough experiments with 10-dimensional and 100-dimensional patterns are also described. It is concluded that certain of these training methods can be expected to give good performance in complex pattern classifying tasks involving multi-modal pattern distributions. The report contains an appendix presenting a new theorem on training a linear machine. Author

N66-10910# Naval Personnel Research Activity, San Diego, Calif.
PREPARATION FOR PROBLEM SOLVING: STRUCTURAL VS. STRATEGY PRETRAINING
Edward A. Rundquist, John D. Ford, Jr., David J. Chesler, William D. Rohwer, Jr., and Harriet M. Braunstein Jul. 1965 62 p refs
(STB-66-1; AD-619705)

In an attempt to answer questions regarding performance improvement in complex applied problems, an experiment was designed to examine the effects of pretraining on the efficiency of concept attainment. Two principal varieties of pretraining were provided to groups of college students whose subsequent performance on five criterion tasks was compared with that of Ss who received no pretraining. The Ss were taught either to analyze problem materials into their structural components or to apply a strategy for the solution of concept attainment problems. In either case, the training was relatively extensive, consuming ten one-hour sessions for each S. The criterion battery comprised three typical laboratory concept attainment tasks of more than twenty problems each, one concept identification task and a fifth task that required the attainment of sequential or temporal concepts. The dependent measures of principal interest revealed slight, reliable, but insubstantial increments in the performance of Ss given strategy pretraining but not for those given structure pretraining. The most powerful effect of strategy training was to increase dramatically the tendency of Ss to withhold hypotheses until sufficient information had been acquired to insure accuracy. The discrepancy between these results and those reported previously is considered and the utility of laboratory concept attainment tasks for applied research is questioned. Author (TAB)

N66-10939*# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
A STUDY OF THE FEASIBILITY OF DETECTING EXTRATERRESTRIAL LIFE BASED ON THE EXCHANGE BETWEEN WATER AND OXYANIONS AND A STUDY OF ENERGY EXCHANGE IN AUTOTROPHIC LIFE Final Report
B. Kok Aug. 1965 73 p refs
(Contract NASw-1054)
(NASA-CR-67924) CFSTI: HC $3.00/MF $0.75 CSCL 06

An extraterrestrial life detection system is proposed based on the detection of enzymes by means of their ability to catalyze the exchange of O^{18} between a labeled oxyanion and water. Experimental data are included to show that with such preparations as whole cells, cell-free extracts, whole insects, plant extract, and random soil samples, the rate of exchange of O^{18} from PO_4 and NO_3 is appreciable and measurable. The theoretical basis of the method is detailed, and underlying assumptions applicable to all forms of earth life are listed. Possible procedures to be followed aboard the Martian probe are discussed, and details on sample analysis, the inlet, and the mass spectrometer are included. An extensive literature survey was conducted to compile existing data, and the findings are reported. Studies were also undertaken to investigate the biochemistry of the energy metabolism of the chemosynthetic bacteria, because of the possible similarities of the extraterrestrial life forms to the terrestrial chemosynthetic microorganisms; the results are summarized. M.G.J.

N66-10956*# Mississippi State Univ., State College.
SOME OF THE EFFECTS OF THREE AMINO ACIDS ON THE GROWTH OF *HYDROGENOMONAS EUTROPHA*
Eve Elliott Blake (M.S. Thesis) Jan. 1966 112 p refs (Grant NsG-650)
(NASA-CR-67927) CFSTI: HC $4.00/MF $0.75 CSCL 06A

Investigations were conducted to determine if the presence of L-tyrosine, L-alanine, and L-glutamic acid in a medium would impair the growth and physiology of *Hydrogenomonas eutropha*. These compounds were found in the basic medium following growth under autotrophic conditions. Preliminary studies indicated that these amino acids were not toxic. In a series of growth studies using cells grown under autotrophic conditions, *Hydrogenomonas eutropha* was used to inoculate Repaske's medium and Repaske's medium containing the amino acids. Growth under an atmosphere of hydrogen, oxygen, and carbon dioxide in a ratio of 6-2-1 was compared with growth under air. Under an atmosphere of the gas mixture all three of the amino acids caused a marked increase in growth as indicated by turbidity measurements. The increase in cell mass was several fold that in Repaske's medium. The least increase over that of control medium was obtained when 0.1% glutamic acid was in the culture medium and was 2.06. The greatest increase occurred when 1% tyrosine was in the culture medium and was 4.12. R.W.H.

N66-10963# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
BIOLOGICAL TOLERANCE TO AIR BLAST AND RELATED BIOMEDICAL CRITERIA
Clayton S. White, I. Gerald Bowen, and Donald R. Richmond
Washington, AEC, 18 Oct. 1965 258 p refs
(CEX-65.4) CFSTI: $2.75

Experience with animals exposed in a variety of above and below ground structures during full-scale field operations were reviewed. The data were assembled and summarized to illustrate the nature of the blast-induced problems of significance in protective shelters, open as well as closed. Potential hazards were related to the following: various patterns of variation in environmental pressure; translational events associated with transient, high-velocity winds, ground shock and gravity involving the impact of energized inanimate objects on the one hand the consequences of whole-body displacement on the other; non-line-of-sight thermal phenomena including hot objects and rapidly moving hot, dust-laden air, and debris; and dust, in the respirable size range, sufficiently high in concentration even in closed shelters as to warrant design measures to minimize or eliminate the occurrence of small particulates whether arising from wall spalling or otherwise. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N66-10052 Battelle Memorial Inst., Columbus, Ohio. Engineering Physics Dept.
ANALYSIS OF HOSTILE-ENVIRONMENT METHODOLOGIES
John W. Clark *In* AEC Remotely Operated Special Equipment [1964] p 4–26 (See N66-10051 01-15) CFSTI: $4.00

Special tools and equipment for performing manual work in hostile, dangerous, or hazardous environments and in areas inaccessible by man are discussed. A methodological classification scheme based upon the way in which the operator is protected from the hostile environment is proposed for the large number of tools, methods, and equipment used in hostile environment operations. Examples of each methodology are included and the functions which must be accomplished by a "remote control" system are defined. M.R.W.

N66-10055 Philco Corp., Blue Bell, Pa.
A STUDY TO INVESTIGATE THE FEASIBILITY OF UTILIZING ELECTRICAL POTENTIALS ON THE SURFACE OF THE SKIN FOR CONTROL FUNCTIONS
Lee Harrison *In* AEC Remotely Operated Special Equipment [1964] p 100–157 (See N66-10051 01-15) CFSTI: $4.00

The development of myographic signal-handling equipment, and the application of computer programming techniques to myographic signal data is investigated to study the feasibility of using electromyographic signals to generate control inputs to actuators and devices. Myographic data was analyzed to discern, and thus to be able to process, the significant parameters of typical myo-signals. A non-deterministic pattern-classification, computer technique was used to study the myographic patterns which were analyzed for power spectrum, zero and threshold crossings, and RMS values. The RMS value of the waveform appears to be the most acceptable parameter of the signal since it was found to be relatively linear with force. This was verified in the literature. An electronic device called a myocoder was designed to prepare biological signals for computer processing by amplifying the raw electromyographic waveform, extracting the parameter of RMS value, and quantizing this value for subsequent processing. Sketches and block diagrams are included. M.R.W.

N66-10056 Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
DESIGN AND TEST OF A FULL-SCALE WEARABLE EXOSKELETAL STRUCTURE
Neil J. Mizen *In* AEC Remotely Operated Special Equipment [1964] p 158–197 refs (See N66-10051 01-15) CFSTI: $4.00

The development of a wearable exoskeletal device, employing powered joints, to be worn by man to amplify his muscular strength and to increase his endurance in the performance of tasks requiring considerable physical exertion is investigated. The concept is termed the Man Amplifier and consists of a structural exoskeleton with appropriate articulate joints, compatible with those of man. The servomotors powering the joints respond to the output of sensors linking man and machine and cause the appropriate mechanism to follow the natural motion of it's human counterpart. A portable, self-contained power pack is attached to the back of the exoskeleton to provide the necessary power. Tests were conducted to determine: the minimum number of joints necessary to enable

the wearer to perform useful work tasks; mean and maximum velocities at each joint; and motion ranges and dynamic responses. An arm-aid designed as a research device for basic studies in man–machine communications and control in orthotics and prosthetics is also considered. M.R.W.

N66-10057 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.

HUMAN FACTORS IN REMOTE HANDLING: A REVIEW OF PAST AND CURRENT RESEARCH AT THE 6570th AEROSPACE MEDICAL RESEARCH LABORATORIES

William N. Kama *In* AEC Remotely Operated Special Equipment [1964] p 198–209 refs (See N66-10051 01-15) CFSTI: $4.00

Human factor problems relating to the design and use of remote handling systems and manipulators in support of nuclear powered systems and extravehicular space operations is investigated. Factors considered and discussed are task variables, equipment design, operator performance, sensory/perceptual problems, and controls. M.R.W.

N66-10058 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.

A SERVO-RESTRAINT SYSTEM FOR ANTI-G PROTECTION

Warren L. Loudon *In* AEC Remotely Operated Special Equipment [1964] p 210–223 (See N66-10051 01-15) CFSTI: $4.00

Servo-restraint devices to prevent movement of the body and extremities under steady and varying G forces are described and discussed. It is envisioned that the servo-restraint concept will be applied to aerospace vehicles to make control of these vehicles possible under severe and varying G levels by allowing only voluntary movements of the operator and permitting reliable operation of controls through maintenance of kinesthetic reliability. Escape will be made easier and more successful by overcoming the difficulty of the operator in positioning himself and operating the escape mechanism. Photographs of these devices are included. M.R.W.

N66-10059 Philco Corp., Philadelphia, Pa.

CONTROL: THE UNIVERSAL PROCESS

Roy Wirta and Richard Sprince (General Electric Co., Scranton, Pa.) *In* AEC Remotely Operated Special Equipment [1964] p 224–232 (See N66-10051 01-15) CFSTI: $4.00

Requirements for the development of controls which will match human and machine characteristics are discussed. Factors considered in the control process are the human operator; the command data unit; the task to be performed by the machine; and the sensory feedback unit. Several servo-manipulators, remote-handling devices, and man/machine integration systems are examined in terms of the design and function of their controls. M.R.W.

N66-10060 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.

AN EVALUATION OF PROPOSED APPLICATIONS OF REMOTE HANDLING IN SPACE

Gerald P. Chubb *In* AEC Remotely Operated Special Equipment [1964] p 233–247 refs (See N66-10051 01-15) CFSTI: $4.00

The feasibility of applying remote-handling devices to assembly and maintenance tasks in space is investigated. The telechiric and encapsulation approaches are two of the methods considered and a design evaluation is made based on the human factors aspect of the configuration. The use of myoelectric control is mentioned. M.R.W.

N66-10066 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

RECOMMENDATIONS AND DISCUSSION BY PARTICIPANTS REGARDING FUTURE RESEARCH AND DEVELOPMENT WORK

In AEC Remotely Operated Special Equipment [1964] p 364–379 (See N66-10051 01-15) CFSTI: $4.00

A discussion by individuals who are specialists in the design and manufacture of remote handling devices, manipulator systems, prosthetic equipment, and remotely controlled tools is presented concerning improvements and research that should be made in order to advance the present state-of-the-art in these areas. Further research is needed to incorporate computer program decision-making into the remote handling field. Methods for improving communications between organization and groups which manufacture and conduct research in this field are suggested. M.R.W.

N66-10067 Veterans Administration, New York.

MANIPULATORS AND UPPER-EXTREMITY PROSTHETICS

Eugene F. Murphy *In* AEC Remotely Operated Special Equipment [1964] p 380–390 refs (See N66-10051 01-15) CFSTI: $4.00

Various motions, gripping, and control requirements for the design of artificial limbs and hands for unilateral and bilateral amputees are investigated. Prehension patterns of human hands are studied to devise a more versatile and functional prosthetic device. A number of remote handling devices, manipulators, and mechanical hooks and tongs are examined and discussed. M.R.W.

N66-10319*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

INTERFACE TEST FOR EVALUATING ABILITY OF PRESSURE-SUITED SUBJECTS TO PERFORM LUNAR SCIENTIFIC TASKS

Earl V. La Fevers and Curtis C. Mason Washington, NASA, Nov. 1965 30 p

(NASA-TM-X-1170) CFSTI: HC $2.00/MF $0.50 CSCL 05E

Mobility studies were conducted with subjects wearing an Apollo developmental space suit pressurized to 3.7 psig. Activities were performed to determine time and ability for climbing and traversing, and for performing scientific experiments. Velocity for climbing and traversing varied from 0.06 mile per hour for climbing a 30° extremely rough-surfaced slope to 2.84 miles per hour for walking on an ideal surface. Subjects were able to perform the entire range of scientific tasks as long as the task did not require delicate manipulation on a surface at the level of the subject's feet. Only the simpler tasks could be performed at this level. Further improvement in both exploration techniques and suit design is required so that all scientific tasks in the tests can be performed. L.S.

N66-10369# Société Bertin et Cie, La Garenne-Colombes (France).

MECHANICAL CHARACTERISTICS OF A PURE FLUID RESPIRATOR WITH CURVED WALLS, PAPER F3

Cyrille Davlin and Marcel Kadosch [1965] 11 p Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and Coll. of Aeron. Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

A prototype of an artificial respirator without moving parts has been developed, applying the principles of fluid switching. The combination of a normal exit and another exit with a curved convex wall displays interesting characteristics which lead to a high efficiency of power jet. The device is now tested in hospitals in view of homologation for clinical applications. Author

N66-10370# Joint Publications Research Service, Washington, D. C.

PROBLEMS IN BIONICS

P. Gulyayev 21 Oct. 1965 6 p Transl. into ENGLISH from Med. Gazeta (Moscow), 24 Aug. 1965 p 3

(JPRS-32502; TT-65-32981) CFSTI: $1.00

Bionic models were constructed on the functional basis of the living organism itself as equivalence of relationships with respect to form. The models reproduce the relationships of life processes, predict the trend of the processes, their change with time, magnitude, and other variables. Either growth laws, or random processes, can be used by bionic computers for optic or auditory methods of diagnosis in a number of physiological processes. Self-organizing bionic machines constructed after neuron models were able to read printed text, distinguish vocal sounds, and obey spoken commands. G.G.

N66-10608*# Westinghouse Electric Corp., Baltimore, Md. Defense and Space Center.

NASA INDUSTRIAL APPLICATIONS STUDY. INDUSTRIAL REVIEW FOR IMPROVED ELECTRODE FOR BIOPOTENTIAL MEASUREMENT AT THE SKIN

Herman Schneid 8 Dec. 1964 12 p refs

(Contract NASw-952)

(NASA-CR-67798) CFSTI: HC $1.00/MF $0.50 CSCL 05B

A biopotential electrode developed for the Mercury project is discussed in terms of its potential civilian applications in medicine. These applications include monitoring of cardiac patients, long term study of heart diseases, electroencephalography, fetal electrocardiography, electrohysterectomy, impedance pneumography, muscle biopotentials, and animal husbandry. The electrode has the desirable features of low resistance, resistance to motion artifact, and low irritation. Methods for reducing its cost for civilian use are discussed. R.N.A.

N66-10758*# Kansas Univ., Lawrence. Engineering Science Div.

PERFORMANCE OF HUMAN OPERATORS UNDER VARIOUS SYSTEM PARAMETERS

Hajime Akashi and Saad Mahmood Jun. 1965 37 p refs *Its* Studies in Eng. Mech. Rept.-22

(Grant NsG-298)

(NASA-CR-67625) CFSTI: HC $2.00/MF $0.50 CSCL 05H

The performance of human operators was investigated for varied system parameters. A practical performance index was defined, and the relation between the parameters and the performance index was found for a range of values of the parameters. Several operators with different control experience were tested, and it was found that human control capability can be represented by a hyperbolic curve in the parameter plane of gain and time constant. The result may be used in the design of man-machine systems that anticipate some unusually difficult situations which the operator may be required to deal with. Author

N66-10782# Naval School of Aviation Medicine, Pensacola, Fla.

PILOT ATTITUDES ON DARK ADAPTATION AND RELATED SUBJECTS

Robert S. Kennedy and Thomas E. Berghage Jun. 1965 10 p refs *Its* Special Rept. 65-4

(AD-620016)

The night accident rate for carrier landings is five times the day rate. This raises the possibility that visual errors caused by lack of dark adaptation may be involved. Completed questionnaires regarding the importance of being adapted to darkness prior to and during night time aircraft carrier operations were received from 71 experienced naval aviators. Analysis of their responses showed that, generally, their opinion of the usefulness of dark adaptation is an individual matter; if the aviator had never experienced its need, he was less likely to be concerned. The greatest value to an aviator of being adapted to the dark was said to be during pre-flight operations, i.e., on deck, when moving to and around the aircraft, taxiing, and during launch. After being airborne, however, the aviator's major visual problem lies in reflection of the instrument lights which reduces visibility and can affect dark adaptation. Poor knee-board lighting and difference in instrument light intensity were mentioned as other irritating problems. Author (TAB)

N66-10788# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPACE CLOTHING OF SUBJUGATORS OF OUTER SPACE

V. Krichagin 18 Jun. 1965 9 p Transl. into ENGLISH from Med. Gazeta (USSR), 25 Mar. 1965

(FTD-TT-65-604/1+4; AD-620099)

A synopsis on the function and advantages of using space clothing in outer space exploration is presented. Reviewed are methods for eliminating or modifying the effects of bio-physiological responses induced by high altitudes, atmospheric pressure, solar radiation, and the pressure within the space suit. Emphasized is the importance of research in high-altitude physiology and engineering design to the development of more reliable clothing for exploration of airless outer space. S.C.W.

N66-10820# Syracuse Univ., N. Y.

VERBAL CONDITIONING BY A SIMULATED EXPERIMENTER

Richard Videbeck and Henry Bates (Missouri Univ.) Apr. 1965 15 p refs Prepared in cooperation with Missouri Univ.

(Contract Nonr-2296(02))

(TR-16; AD-620160)

The present study sought to control for absolute consistency in experimenter behavior and reaction to the subject's verbal emissions. To attain this end, a computer was programmed to stimulate the functions of the experimenter. Not only were the instructions to the subject and the experimental stimuli presented in a standardized manner, but invariance in the reinforcing operations was attained. The computer was programmed to recognize the preselected response class and reinforce it with the typed message 'very good.' The result is a highly replicable and consistent presentation of stimuli and reinforcement. TAB

N66-10831# Rome Air Development Center, Griffiss AFB, N. Y. Display Techniques Branch.

COLOR SPECIFICATION FOR ADDITIVE COLOR GROUP DISPLAYS

Edward F. Rizy Aug. 1965 33 p refs
(RADC-TR-65-278; AD-621068)

Nine pairs of dichroic filters were used in a xenon-source additive color projector to determine their effects upon observer performance in a search-and-discrimination task with seven color codes. The objective was to define performance parameters preliminary to setting filter specifications. Results indicated that a blue filter reflecting wavelengths well into the green region facilitated performance in the majority of color codes. A red filter close to the infrared in reflectance reduced performance in most codes. The most efficient color code, regardless of filter, was red. Green, blue and cyan were least efficient. Recommendations were made suggesting a blue filter of approximately 516 mμ cutoff and a red filter with a cutoff between 581 and 595 mμ for optimum observer performance in the context of a seven-color code. Performance criteria were compared and an alternate filter option was described.

Author (TAB)

N66-10918# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
LIFE SUPPORT SYSTEMS EVALUATOR CONSTRUCTION TECHNIQUES
William F. Mickelson May 1963 29 p
(AMRL-TDR-63-43; AD-412649)

The construction, plumbing, capability, and operation of the Life Support Systems Evaluator are described. The evaluator is a research tool for determining technical feasibility of techniques and principles involved in operation and design of life support equipment by integrated evaluation studies. The evaluator is operational and has provided very good results.

Author

N66-10938*# Hamilton Standard Div., United Aircraft Corp., Broad Brook, Conn.
MARS LANDING AND RECONNAISSANCE MISSION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM STUDY. VOLUME 2: SUBSYSTEM STUDIES Final Report, 15 Jul. 1963–15 Mar. 1964
[1964] 408 p refs
(Contract NAS9-1701)
(NASA-CR-67935; SLS-414-2) CFSTI: HC $7.00/MF $2.00
CSCL 06K

Results of subsystem studies used as supporting data for the final system analysis are presented in a parametric form to permit application of the data to the requirements of future Mars missions. The subsystems analyzed include CO_2 removal, transfer, and reduction; water electrolysis; atmospheric storage; water reclamation; waste management; contaminant control; personal hygiene; radiators, heat exchangers and water separators, and fans. General conclusions are presented on each approach considered to demonstrate the preliminary assessment on the subsystem level. To allow full flexibility of use, the data illustrate the fixed weight, power, and expendable requirements in all possible cases.

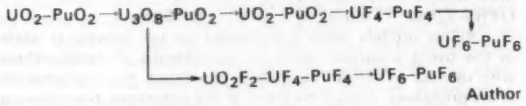
S.C.W.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N66-10074# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
REACTOR FUEL REPROCESSING BY VOLATILIZATION [RETRAITEMENT DES COMBUSTIBLES IRRADIES PAR VOLATILISATION]
J. Schmets, J. Broothaerts, G. Camozzo, F. Coenen, A. Francesconi et al Aug. 1965 112 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-049-61-4 RDB)
(EUR-2088.f)

Various fuel reprocessing schemes have been studied. The main investigations have been carried out on the following cycle including a variant:



Author

N66-10148# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
PROTON ADSORPTION AT THE FERRIC OXIDE/AQUEOUS SOLUTION INTERFACE. A KINETIC STUDY OF ADSORPTION
G. Y. Onoda, Jr. and P. L. de Bruyn Aug. 1965 34 p refs Submitted for Publication
(Contract Nonr-1841(86))
(TR-1; AD-467670)

A kinetic study of the adsorption of potential-determining ions (H+) at the ferric oxide (Alpha-Fe203)/solution interface is reported. The experimental results obtained by potentiometric titrations of suspensions of the synthetically-prepared solid indicate that a two-step process operates at the interface. The observed results may be explained by a rapid adsorption (or desorption) of protons at the surface of the oxide, followed by the slow diffusion of the adsorbed proton into (or out of) a goethite-like interphase separating the bulk anhydrous oxide from the solution phase. Corroborative evidence for the proposed model and mechanism is supplied.

Author (TAB)

N66-10157 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING THE COMPOSITION OF FILLING A DIFFUSION CHAMBER IN ITS SENSITIVE LAYER
L. V. Bakanov, A. P. Grayevskiy, V. D. Lebedev, and M. V. Stabnikov *In its* Instr. and Exptl. Tech. 30 Jun. 1965 p 13a–16 refs (See N66-10154 01-23)

Measurements were made of the absolute content of methyl alcohol in the sensitive layer at various pressures of the gas filling the chamber. The results of measuring the alcohol content at 1 and 2 atm are described in detail. A control sample method was used because it allows a sufficiently reliable determination of the summary content of working liquid in form of vapor and droplets. Measurements were taken with preliminary expansion of chamber volume and without preliminary expansion, and at a purifying field and in the absence of a purifying field. The results indicate that the total number of methyl alcohol molecules does not exceed 4% of the number of gas molecules of the gas filling the chamber.

R.R.D.

N66-10159# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
APPLICATIONS OF ATOMIC ABSORPTION SPECTROSCOPY

J. Allen Wheat Jul. 1965 20 p refs
(Contract AT(07-2)-1)
(DP-980) CFSTI: $1.00

Procedures were developed for analyzing ten types of samples for numerous elements by atomic absorption spectrometry. Methods of preparing the samples for analysis are described. The procedures can be extended to other types of samples.
Author

N66-10172# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHEMISTRY AND TECHNOLOGY OF FUELS AND LUBRICANTS Selected Articles
30 Jun. 1965 22 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 4, 1964 p 22–26, 66–69
(FTD-TT-65-324/1+4; AD-618045)

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1. ENLARGING THE RAW MATERIALS RESOURCES OF PARAFFINS ON THE BASES OF PARAFFINIC CRUDES OF THE UKRAINE N. Ya. Rudokova, B. K. Sheremeta, T. A. Kvyatkovskaya, and R. G. Kolosyuk p 1–7 refs (See N66-10173 01-06)

2. METHODS OF PREVENTING THE FORMATION OF ICE CRYSTALS IN FUELS K. O. Averbakh, G. S. Shor, O. K. Smirnov, and G. S. Gol'din p 8–18 refs (See N66-10174 01-06)

N66-10173 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ENLARGING THE RAW MATERIALS OF PARAFFINS ON THE BASES OF PARAFFINIC CRUDES OF THE UKRAINE
N. Ya. Rudokova, B. K. Sheremeta, T. A. Kvyatkovskaya, and R. G. Kolosyuk *In its* Chem. and Technol. of Fuels and Lubricants 30 Jun. 1965 p 1–7 refs (See N66-10172 01-06)

Data are presented for manufacturing low melting paraffins at Ukrainian petroleum refining plants on the basis of the following distillates: diesel fuel, vacuum gas oil, filtrates, and runoffs from the manufacture of paraffins by the filter pressing and sweating method.
R.R.D.

N66-10174 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF PREVENTING THE FORMATION OF ICE CRYSTALS IN FUELS
K. O. Averbakh, G. S. Shor, O. K. Smirnov, and G. S. Gol'din *In its* Chem. and Technol. of Fuels and Lubricants 30 Jun. 1965 p 8–18 refs (See N66-10172 01-06)

The behavior of water in hydrocarbon fuels at low temperatures and methods to prevent the formation of ice crystals in these fuels are discussed in detail. Ice crystals forming in fuels create a hazard in the operation of aircraft engines. It is indicated that the use of admixtures to prevent the crystallization of water at low temperatures is an effective and economical solution to this problem.
R.R.D.

N66-10193# European Atomic Energy Community, Brussels (Belgium).
ELECTRODE OVERVOLTAGES IN MOLTEN FLUORIDES. III: THE ANODIC BEHAVIOUR OF NICKEL ELECTRODES IN MOLTEN KF-NiF_2, KF-NaF-LiF, KF-NaF AND KF-LiF MIXTURES
S. Pizzini, R. Morlotti, and E. Römer 1965 25 p refs Presented at the San Francisco Meeting of the Electrochem. Soc., San Francisco, 9–13 May 1965
(EUR-804.e) CFSTI: HC $1.00/MF $0.50

Anodic overvoltage measurements on nickel electrodes in molten NiF_2-KF, LiF-NaF-KF, NaF-KF and LiF-KF eutectic mixtures have been carried out by means of the galvanostatic, potentiostatic and potential sweep method at temperatures ranging from 450° and 800° C.
Author

N66-10209# European Atomic Energy Community, Brussels (Belgium).
OSCILLOGRAPHIC POLAROGRAPHY OF OXYGEN IONS IN MOLTEN NITRATES
M. Francini and S. Martini 1965 31 p refs Presented at the meeting of the Electrochem. Soc., San Francisco, 9–13 May 1965
(EUR-2496.e) CFSTI: HC $2.00/MF $0.50

A polarographic investigation of the effect of oxide and hydroxyl ions and oxygen gas additions to the molten KNO_3-$NaNO_3$ and $LiNO_3$-$NaNO_3$-KNO_3 mixtures in the temperature range 160–260° C was carried out by single sweep polarography. A dropping mercury electrode was the cathode and an Ag/AgCl electrode acted as reference. The oxide and hydroxyl ions exhibit wave heights linear concentration. The hydroxyl ion is demonstrated to be the only Red species participating at the electrode reaction and by electrooxidation gives rise to an Ox species soluble and diffusing in the mercury. The peak potential of the hydroxyl wave lies in the range + 0.100 ÷ − 0.450 volts vs. the reference electrode depending on the $LiNO_3$ molar fraction of the solvent; and this peak potential variation is correlated to the variation of its activity coefficient. The association constants at different temperatures as well as the Helmoltz free energy changes of association are evaluated.
Author

N66-10215*# Rennsselaer Polytechnic Inst., Troy, N. Y.
AN INVESTIGATION OF SOME REACTIONS OF ACTIVE NITROGEN
David R. Safrany (Ph.D. Thesis) Jun. 1964 186 p refs
(Grants NsG-100-60; AF-AFOSR-174-63)
(NASA-CR-67884; AD-620226) CFSTI: HC $5.00/MF $1.25
CSCL 07C

The reactions of active nitrogen were studied in a fast-flow, low-pressure system using a mass spectrometer whose leak was located directly downstream from the reaction zone. Reactions of metastable $N_2(A3\xi(+)u)$ molecules, produced by means of surface catalyzed excitation, were also studied. The results of the excited molecule experiments indicated that, in general, $N_2(A3\xi(+)u)$ do not play a major role in the reactions of active nitrogen with inorganic and organic substances such as O_2, O_3, N_2O, C_2H_2 and C_2H_4. The reactions of N-atoms with hydrocarbons were studied along the lines of previous workers. It was found that, contrary to earlier work, HCN is not the only major nitrogen containing product formed, but N_2 is also a substantial product. Under certain conditions, NH_3 and CH_3CN can also be major products. Ammonia added to the flame zone of the C_2H_2-active nitrogen reaction was found to react with CH radicals formed, yielding HCN. A general degradation mechanism is proposed involving the attack of the hydrocarbon, in general, by a radical other than the N-atom as the initial step.
Author (TAB)

N66-10217# Holman (John F.) and Co., Washington, D. C.
EXPLOSIVE PROPERTIES OF INITIAL EXPLOSIVES CRYSTALLOGRAPHIC, MOLECULAR, AND QUANTUM-CHEMICAL CONSIDERATIONS

Akira Suzuki Aug. 1965 59 p refs Transl. into ENGLISH from J. Ind. Explosives Soc. (Japan), v. 14, no. 3, 30 Sep. 1963 p 142–163
(Contract DA-44-009-AMC-930(T))
(ERDL-TT-1797-65; AD-620222)

Contents: A historical review of studies on explosive properties of initial explosives; The synthesis and preparation of initial explosives used in the experiment; The impact sensitivity (mainly in low temperature range) of initial explosives; Ignition sensitivity of initial explosives and the secondary structure of their crystals; Analysis of the crystal structure of mercury fulminate; Studies of the properties and explosion mechanism of mercury fulminate based on the image of its crystal; and Quantum-chemical consideration of explosive properties of initial explosives. TAB

N66-10263# California Univ., Berkeley. Lawrence Radiation Lab.
AXIAL DISPERSION IN LIQUID FLOW THROUGH PACKED BEDS
Steven Frank Miller and C. Judson King 24 May 1965 26 p refs
(Contract W-7405-ENG-48)
(UCRL-11951)

Step-function injection and purging of a dilute salt tracer in water was used to measure axial dispersion for low Reynolds number liquid flow through beds of uniform sized, random packed glass spheres. The resultant data and those of several previous studies are coordinated and interpreted in terms of Reynolds number, Schmidt number, and Peclet number. Author

N66-10339*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPECTRAL EMITTANCE OF ALUMINUM OXIDE AND ZINC OXIDE ON OPAQUE SUBSTRATES
Curt H. Liebert Washington, NASA, Nov. 1965 24 p refs
(NASA-TN-D-3115) CFSTI: HC $1.00/MF $0.50 CSCL 07D

An experimental study was conducted to examine the normal spectral emittance of composites of powdered zinc oxide (ZnO) and aluminum oxide (Al_2O_3) and flame-sprayed Al_2O_3 when applied in various thicknesses to substrates of different radiative properties. The emittance measurements were made in air over the wavelength range 1.2 to 14.1 microns at a surface temperature of 880° ± 8° K. Coating thicknesses from 0.05 to 0.41 millimeter (0.002 to 0.016 in.) were applied to substrates having widely different spectral emittances. In addition, some normal spectral reflectances at wavelengths of 0.37 to 2 microns and normal transmittance data from 2 to 15 microns were obtained at room temperature for the ZnO coating on a flat sodium chloride window. Normal spectral emittance of composites made from coatings of powdered ZnO and Al_2O_3 changed appreciably with coating thickness and substrate emittance. For instance, the emittance at wavelengths from 2 to 3 microns of composites of ZnO powder can be reduced by almost one-half when coating thickness changes from 0.05 to 0.41 millimeter (0.002 to 0.016 in.) when applied to a substrate having an emittance of 0.9. The variations of spectral emittance are due, in part, to the high translucence of the ZnO coating. Author

N66-10351# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE USE OF BORIC ACID ESTERS IN ROLE OF ANTIOXIDANTS FOR POLYMERIC MATERIALS
E. I. Rozantsev, L. A. Krinitskaya, and L. S. Troitskaya 20 Aug. 1965 10 p refs Transl. into ENGLISH from Khim. Prom. (Leningrad), no. 3, 1964 p 20–23
(FTD-TT-65-703/1+2+4; AD-620771)

Several phenyl borates of aromatic diols and thiols were synthesized and their ability to impart stability to thermo-oxidation in polypropylene was studied. TAB

N66-10379# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF OBTAINING ORGANOSILICON COMPOUNDS CONTAINING A FERROCENYL RADICAL
L. V. Babare, N. S. Nametkin, and T. I. Chernysheva 24 Jun. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 165718 (Appl. no. 851651/23-4, 8 Aug. 1963) 2 p
(FTD-TT-65-465/1+4; AD-619426)

The invention involves a method of obtaining organosilicon compounds which contain a ferrocenyl radical which has the distinguishing feature that, for the purpose of obtaining compounds with heightened heat resistance, silylferrocenes which contain the bond Si-H are subjected to interaction with di-(vinylarylalkyl)-disiloxane or di-(vinylalkylaryl)-silylbenzene with heating up to 180–200° C in the presence of platinohydrochloric acid as a catalyst. Author (TAB)

N66-10434# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
THE SOLID STATE REACTIVITY AND GLASS CRYSTALLIZATION BEHAVIOR OF SOME ALKALI ALUMINOGERMANATES
H. D. Kivlighn, Jr. Jun. 1965 21 p refs
(RM-280J)

A preliminary examination of the crystallization sequences in some alkali aluminogermanate glasses is described in this paper. The glasses investigated may be represented by the following chemical formulas: $LiAlGeO_4$, $LiAlGe_2O_6$, $NaAlGeO_4$, $Li_3AlGe_3O_9$, $Li_2NaAlGe_3O_9$, and $Li_2KAlGe_3O_9$. Three new compounds were synthesized in the solid state, $KAlGeO_4$, $RbAlGeO_4$, and $CsAlGeO_4$. A simple arithmetical approach is presented for determining the potential existence of six coordinate germanium (IV) in a given glass. Author

N66-10443# Joint Publications Research Service, Washington, D. C.
EFFECT OF DISPERSITY OF THE RAW MATERIAL ON THE PROPERTIES OF PIEZOCERAMICS
I. A. Glozman 20 Oct. 1965 11 p refs Transl. into ENGLISH from Khim. Prom. (Leningrad), no. 2, 1965 CFSTI: $1.00
(JPRS-32487; TT-65-32966)

The quality of piezoceramic materials depends largely on the granulometric composition of the raw material. A good reproducibility of the characteristics of piezoceramics is achieved by using piezoceramic materials produced from raw materials with a high degree of dispersion. Piezoceramic materials of high purity can be obtained by replacing treatment of the charge in ball and vibratory mills with the mixing of ingredients of the charge in mixers. Besides purity, the degree of dispersion is one of the most important indices of the quality of raw materials used in synthesizing piezoceramic materials. R.N.A.

N66-10457# Naval Radiological Defense Lab., San Francisco, Calif.
RAPID ISOLATION OF RADIOSILVER AND CERTAIN OTHER RADIOELEMENTS FROM SOLUTION: APPLICATION TO A SEARCH FOR AG^{121} IN U^{235} FISSION

H. V. Weiss and W. L. Reichert 11 Apr. 1965 8 p refs
(Contract AT(49-2)-1167)
(USNRDL-TR-844)

Rapid separation of silver from cadmium, indium, and tin was effected by filtration through a thin bed of copper powder. This method was applied to a search for Ag^{121} in the thermal neutron fission of U^{235} None was detected and this result indicated that either the half-life of Ag^{121} is substantially shorter than the post fission separation time of 3.5 sec or its yield is inordinately low. The study was extended to examine the behavior of an additional number of elements in the separation. Of the 28 elements studied, only palladium, silver, gold, and mercury were removed from solution to the extent of 70% or more. Selenium, ruthenium, tellurium, and iodine were partly retained by the copper to the extent of 5-33%. Of the remaining 20 metals, with the exception of zirconium and arsenic, appreciably less than 0.1% of the element adhered to the filter bed. This selectivity may allow wider application of the method. Author

N66-10458 General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
OPTIMIZING NEUTRON ACTIVATION ANALYSIS
M. B. Leboeuf [1965] 14 p
(Contract W-31-109-ENG-52)
(TID-21942)

The principal steps in activation analysis are outlined, and some guides are given for optimizing the use of this method for many analytical problems. The results attainable with this method are compared with those attainable by X-ray fluorescence. The computer processing of radioactivity data using the AUGAR program, is discussed. NSA

N66-10472# Liege Univ. (Belgium).
PHYSICO-CHEMICAL RESEARCH ON THE TRANSPLUTONIUM ELEMENTS
F. Caligara, Ph. Dreze, G. Duyckaerts, J. Fuger, J. Goffart et al 1965 30 p refs
(Contract EURATOM-003-61-2 TPUB)
(EUR-2297.e) CFSTI: HC $2.00/MF $0.50

Results are summarized for the following studies: (1) trilaurylamine in hydrochloric acid medium, (2) extraction of lanthanides and actinides with alkyl phosphine oxides, (3) extraction of lanthanides and actinides with di-*n*-butyl phosphoric acid, and (4) electrochemical studies in molten salts. NSA

N66-10490# Pratt and Whitney Aircraft, Middletown, Conn.
SELF DIFFUSION OF NITROGEN IN URANIUM MONONITRIDE
T. J. Sturiale and M. A. De Crescente 8 Sep. 1965 26 p refs
(Contract AT(30-1)-2789)
(PWAC-477)

The self diffusion rate and activation energy for diffusion of nitrogen in uranium mononitride was investigated by the gas-solid exchange method using a stable isotope of nitrogen as a tracer atom. The gas-solid exchange data for all the particle and grain sizes used in the study are tabulated. Diffusion coefficients for both large (125 micron) and small (25 micron) grain size material follow a straight line relation above 1500° C. However, the low temperature data for the small grain size material deviates significantly from the extrapolated high temperature data. This suggests that grain boundary diffusion becomes a dominant factor in mass transport at the lower temperatures. Two additional data points using large grain material were obtained at low temperature to determine the effect of grain boundary diffusion. It was observed that these data points were very near the extrapolated high temperature values. The contribution of enhanced grain boundary diffusion to the total diffusion rate became insignificant when the number of grains per particle was reduced by almost two orders of magnitude. A least squares fit of the low temperature data indicates an apparent activation energy for grain boundary diffusion of 29 kcal/mole. E.E.B.

N66-10493# Western Reserve Univ., Cleveland, Ohio. Ultrasonics Research Lab.
ULTRASONIC STUDIES OF ELECTROLYTES
Ernest Yeager 1 Aug. 1965 38 p refs Presented at the 5th Intern. Congr. on Acoustics, Liège, 7–14 Sep. 1965
(Contract Nonr-1439(04))
(TR-28; AD-620697)

Important developments which have occurred in the application of ultrasonic techniques to the study of the structure and dynamic properties of electrolytic solutions during recent years are discussed with principal emphasis on ultrasonic relaxation and electrical effects attending the propagation of sound waves through such solutions. Sufficient understanding of the various relaxation processes in electrolytic solutions now has been attained that the relaxation frequencies and excess relaxation absorption can often be predicted in advance of ultrasonic measurements from other data. In contrast measurements of the electrical effects, particularly ionic vibration potentials, are still rather uncertain because of the possible superposition of several acoustical effects, and measurements of really quantitative significance are only now becoming available for the most part. Author (TAB)

N66-10497# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE EXTRACTION OF NITROSYLRUTHENIUM NITRATO COMPLEXES FROM NITRIC ACID SOLUTIONS BY DIBUTYL CELLOSOLVE AND BUTEX
D. Scargill, C. E. Lyon, and A. G. Wain London, HMSO, Jun. 1965 18 p refs
(AERE-R-4888)

Partition coefficients of the extractable nitrosylruthenium nitrato complexes have been determined between aqueous nitric acid solutions and the ethers dibutyl cellosolve and Butex. The tetranitrato complex is the most extractable by both these solvents, but, whereas dibutyl cellosolve is a comparatively weak extractant, the extractability of the tetra- and trinitrato complexes by Butex is similar to that of about 35% tri-n-butyl phosphate. The rate constants found for the nitration and equation reactions between the tetranitrato and trinitrato complexes in the dibutyl cellosolve and Butex phases are comparable to those found for these reactions in aqueous nitric acid solutions. Author

N66-10498# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE EXTRACTION OF ZINC BY DITHIZONE RETAINED ON CELLULOSE ACETATE
T. B. Pierce and P. F. Peck Jul. 1965 10 p refs
(AERE-R-4969)

Zinc has been extracted from aqueous solution by dithizone (diphenyl thiocarbazone) on cellulose acetate and the uptake of the element compared with the dithizone content of the solid. The distribution of zinc varied as the second power of the hydrogen ion concentration of the aqueous phase, and the rate of extraction of zinc depended on the amount of organic solvent added to the carrier. Author

N66-10501# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

STUDY OF THE K-MESIC X-RAY SERIES STRUCTURE IN THE μ-ATOMIC CAPTURE IN CHEMICAL COMBINATIONS

V. G. Zinov, A. D. Konin, and A. I. Mukhin 1965 9 p refs In RUSSIAN

(JINR-P-2039) CFSTI: HC $1.00/MF $0.50

The structure of the K mesic x-ray series was investigated in μ^- atomic capture in vanadium and vanadium pentoxide as well as in chromium and chromium oxide. A noticeable redistribution of the different K-line yields is observed in the pure substance and its oxide. Author (NSA)

N66-10506# Oak Ridge National Lab., Tenn.

A LITERATURE REVIEW OF MASS SPECTROMETRIC-THERMOCHEMICAL TECHNIQUE APPLICABLE TO THE ANALYSIS OF VAPOR SPECIES OVER SOLID INORGANIC MATERIALS

J. D. Redman [1964] 28 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-989)

Technical literature was systematically reviewed to assemble a bibliography of published work on mass spectrometric technique and instrumentation for the analysis of vapor species over solid materials, and for the determination of thermodynamic characteristics of the vapor. Of interest are: alkali metal fluoride vapor; appearance potential determinations; and high temperature techniques used with a time of flight mass spectrometer. All pertinent bibliographies and literature surveys published in a given period were searched for references to articles on alkali metal halide vapor pressure, and on fundamental developments in high temperature mass spectrometry. R.W.H.

N66-10509# Battelle Memorial Inst., Columbus, Ohio.

CATHODIC PROTECTION OF THE HYDROFLUORINATOR

P. D. Miller, L. R. Matson, and E. F. Stephan 25 Sep. 1964 13 p

(Contract W-7405-ENG-92)

(BMI-X-312)

The optimum conditions under which cathodic protection could be applied to molten fluoride salt systems are described. In order to obtain the optimum current voltage relationships for use in the cathodic protection experiments, it was necessary to develop polarization curves for the materials, INOR-8, zircaloy, and graphite. The polarization characteristics were obtained by use of a potentiostat using a platinum reference electrode and graphite as an anode. The potentiostat automatically maintained a fixed potential between the platinum and INOR-8 electrodes. The control was effected by automatically varying the current-potential relationship between the graphite and the INOR-8. The polarization curves were plotted by progressively changing the potential settings and reading the corresponding currents. The results indicated that the graphite could be polarized anodically, but the INOR-8 could not be polarized. The polarization curves shown for INOR-8 and graphite exposed under a helium sparge showed that the corrosion of INOR-8 would be less than under hydrogen fluoride. It was stated that in salt compositions the initial open circuit potential developed between zircaloy and the other electrodes was 1200 to 1500 mv. The zircaloy was negative, indicating that it was always anodic in the cell. R.W.H.

N66-10510# Argonne National Lab., Ill.

ABSORPTION SPECTRA OF ALKALI METAL TELLURIDES IN MOLTEN ALKALI HALIDES

D. M. Gruen, R. L. Mc Beth, M. S. Foster, and C. E. Crouthamel [1964] 13 p Presented at the 148th Meeting of the Am. Chem. Soc., Chicago, 30 Aug.–4 Sep. 1964

(Contract W-31-109-ENG-38)

(Conf-571-15)

From American Chemical Society 148th National Meeting, Chicago, Aug.–Sept. 1964. Absorption spectra are reported for the following mixtures and temperatures: Li_2Te in LiCl–KCl eutectic at 400 to 1000° C, Li_2Te in LiCl–LiF at 525° C, Li_2Te in CsCl at 700° C, and Cs_2Te in CsCl at 700° C. It is suggested that the ionization $Li_2Te \rightarrow LiTe^- + Li^+$ occurs, and that the spectra are due to the $LiTe^-$ species. The cell and furnace used in the study are described. (NSA)

N66-10516# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POLAROGRAPHIC DETERMINATION OF THE Si-H BOND NEXT TO Si-Si IN POLYORGANOSILOXANES

J. Cermak and P. Dostal 23 Jul. 1965 15 p refs Transl. into ENGLISH from Collection of Czech. Chem. Commun., ARTIA, (Prague), no. 28, 1963 p 1384–1390

(FTD-TT-65-399/1+2+4; AD-468228)

A method of determining the Si-H bond in organosilicon compounds was worked out, based on their oxidation due to mercury (II)-chloride with subsequent polarographic determination of the mercury decrease. It is possible to determine Si-H bonds of polyorganosiloxanes also in the presence of Si-Si bonds and unsaturated compounds. The standard deviation of the method for simple substances amounts to $\pm 0.3\%$.

Author (TAB)

N66-10538# Joint Publications Research Service, Washington, D. C.

KINETICS OF POLYMERIZATION OF ALPHA-OLEFINS BY ZIEGLER-NATTA CATALYSTS

19 Oct. 1965 27 p refs Transl. into ENGLISH from Hua-hsueh T'ung-pao (Peking), no. 12, 14 Dec. 1964 p 28–34, 64

(JPRS-32455; TT-65-32934) CFSTI: $2.00

The polymerization kinetics of the alpha-olefin by Ziegler catalyst were studied and compared with other systems. It was shown that the polymerization rate increased with increased concentration of the organometallic catalyzer compound. The relationship between the polymerization rate and the concentration of transition metal salts was proportional to the surface area in their solid phase. Increased temperatures were favorable to complex activity and chain propagation, but did not increase the formation of complex and monomer adsorption. Analyses of the different types of chain transfer, chain termination, and their respective occurrences established a dependence on such factors as the properties and concentration of $TiCl_3$, the properties of the organometallic compound used, pressure of the monomer, etc. G.G.

N66-10560# Naval Civil Engineering Lab., Port Hueneme, Calif.

AN INVESTIGATION OF X-RAY ANALYSES OF PAINT PIGMENTS

Samuel H. Bassett and Joseph B. Crilly 14 Jun. 1965 19 p refs

(N-732; AD-467073)

The feasibility of using X-ray techniques in the chemical analyses of paint pigments was investigated as a part of the

task on Spectrographic Analysis of Paint. It appears to be feasible, with certain qualifications considered in this note, to make an analysis of pigment compounds suspended in paint by the use of X-ray techniques. Author (TAB)

N66-10572# TRW Systems, Redondo Beach, Calif. Quantum Physics Lab.
RESEARCH ON PHOTOTROPIC DYE-ENZYME SYSTEMS Informal Progress Report, Period Ending 15 Jul. 1965
J. M. Brake, J. L. Kropp, and R. S. Moore 15 Jul. 1965 36 p (Contract AF 33(657)-11708)
(STL-4133-6005-RU-000; AD-472101)

This report describes research on the design of a flash-blindness filter utilizing dye-enzyme systems. A program was carried out to evaluate suitable dyes and 9 dyes were tested for solubility and absorption spectra in water and methanol; their phototropic behavior was also tested in water. Three Fuchsine, Sevron Green B, and Malachite Green dyes are being tested further in methanol. Extensive investigations with Acid Fuchsine in methanol-water mixture revealed that the phototropic behavior of the dye improves when water is present to the extent of 30% or more. When water constituted less than 30% of the mixture, the other dyes gave poor results. Some new reducing agents have been found, but $NaHSO_3$ and NH_4HSO_3 are still preferred. The enzymes glucose oxidase, urease and papain were studied to determine the part of the enzyme that bleaches the dye. Author (TAB)

N66-10591# Ministry of Aviation, Pinner (England). Technical Information and Library Services.
QUANTITATIVE INVESTIGATIONS OF RADICAL REACTIVITY BY THE METHOD OF CONCURRENT REACTIONS [KOLICHESTVENNYE ISSLEDOVANIYA RADIKAL'NOI REAKTSIONOSTI METODOM KONKURIRUYUSHCHIKH REAKTSII]
M. V. Brazilevskii and K. S. Bagdasar'yan Sep. 1965 10 p refs Transl. into ENGLISH from Kinetika i Kataliz (USSR), v. 5, no. 2, 1964 p 215–220
(TIL/T-5545) CFSTI: HC $1.00/MF $0.50

By the method of concurrent reactions the relevant velocity constants of reaction of the phenyl radical with phenol, aniline and anisole were determined. For phenol and aniline the effective values of the constants for the reaction of the detachment of hydrogen dimish with increase of the concentration, a fact which is associated with the association of molecules of this substance on account of the formation of hydrogen bonds. The relative constants were determined for the reaction of detachment of hydrogen from the dissociated form of phenol and aniline and from the associated form of phenol. A consideration was made of the cause of the high reactivity of atoms of hydrogen in phenol and aniline. Earlier a method was suggested for the determination of the relative constants of the speeds of combination of the phenyl radical with the aromatic compound of ArH and the detachment of hydrogen by this radical. The method is based on the concurrence of the reaction of the phenyl radical with the molecule ArH and with carbon tetrachloride. Author

N66-10599# European Atomic Energy Community, Brussels (Belgium).
WATER SOLUBILITY IN MOLTEN ALKALI NITRATES
G. Bertozzi Aug. 1965 13 p refs Presented at the meeting of the Electrochem. Soc., San Francisco, 9–13 May 1965
(EUR-2495.e) CFSTI: HC $1.00/MF $0.50

Water vapor solubility is reported in pure lithium nitrate and in lithium–sodium and lithium–potassium nitrate mixtures, at water vapor pressures up to 30 torr, in the temperature range 230 ÷ 280° C. The dissolution process is reversible, i.e., no hydrolysis reactions occur. The ion-dipole interaction energy is taken into account, and it is shown to be the most relevant parameter in determining the dissolution process. Thermodynamic quantities for the solution equilibrium are given. Author

N66-10624# Bureau of Mines, Morgantown, W. Va.
INVESTMENT AND OPERATING COSTS FOR CHEMICAL AND PETROLEUM PLANTS Bibliography, Jan.–Dec. 1964
Sidney Katell and William C. Morel 1965 136 p refs
(BM-IC-8265)

An annotated bibliography is presented on investment, and construction and operating costs for chemical and petroleum plants. Other subjects covered include cost estimating methods and theory, reports on construction projects, nuclear developments, water desalination and purification, and increasing use of computers in the process and development industries. R.N.A.

N66-10652*# Aerojet-General Corp., Azusa, Calif. Chemical and Structural Products Div.
RESEARCH ON PROCESSES FOR UTILIZATION OF LUNAR RESOURCES Final Report, 22 Apr. 1963–15 Jul. 1965
S. D. Rosenberg, G. A. Guter, F. E. Miller, and R. L. Beegle, Jr. Aug. 1965 118 p refs *Its* Rept.-3049, Final
(Contract NAS7-225)
(NASA-CR-67821) CFSTI: HC $4.00/MF $0.75 CSCL 07B

Several experiments demonstrated that with the use of specially designed inlet tubes, methane reacts with natural silicate materials at 1600° C to form carbon monoxide, hydrogen, silicon, trace metals, and slag. Nearly quantitative carbon balances were achieved. Reactor materials were found which allow the reaction to run at 1600° C for long time periods. Three different nickel-containing catalysts were evaluated. In addition, a determination was made of the effects on catalyst activity of several impurities in the reactant gas and of the feasibility of achieving the reduction reaction without catalyst. Virtually quantitative reduction of carbon monoxide with hydrogen to form methane and water was obtained using Catalyst C-0765-1001 under the following conditions: H_2/CO mole ratio, 3:1; space velocity, 1000 hr^{-1}; catalyst bed temperature, 250° C; and catalyst bed pressure, 6.1 atm. Two continuous long-duration runs were made (60 and 90 days, approximately) using a single catalyst charge. No measurable decline in catalyst activity was noted; quantitative yields of methane and water were obtained. Author

N66-10693# Maryland Univ., College Park.
HOMOGENEOUS AND GRAFT COPOLYMERIZATION OF STYRENE BY IONIZING RADIATION
Sundaresa Srinivasan (Ph.D. Thesis) [1965] 43 p refs
(Contract AT(40-1)-2845)
(TID-21885)

Measurements were made of polymer addition to polyethylene films and polyethylene fluff immersed in liquid styrene and exposed to gamma radiation; in addition, the formation of polystyrene dissolved in styrene was determined. The results lead to three conclusions: (1) the bulk of the polymer addition to polyethylene films is occluded homopolymer; (2) the true graft of styrene to polyethylene follows a kinetic mechanism that is very similar to that of the polymerization of liquid styrene; (3) the actual graft process and the dissolved homopolymer formation have an anomalously low activation energy in the region 20°–40° C. An attempt was made to explore, confirm, and explain the nonlinear behavior of the

Arrhenius plot of the homopolymer formation in the grafting reaction through detailed studies on pure liquid styrene. Radiation-induced polymerization rates and molecular weights were measured over a wide range of temperatures and dose rates; similar measurements were made in thermal polymerization studies. The results are compared with many investigations already published. NSA

N66-10721# California Univ., Livermore. Lawrence Radiation Lab.
CHEMICAL BONDING AND THE SULFUR K-X-RAY SPECTRUM
D. W. Wilbur and J. W. Gofman 20 Jun. 1965 12 p refs
(Contract W-7405-ENG-48)
(UCRL-12496)

Sulfur K_β intensities and K_α energies were studied in a series of sulfur compounds to shed light on their relationship to each other and to the charge and overall chemical state of the sulfur atom. The intensity and energy parameters display an approximately linear relationship for compounds involving sulfur in three or more bonds. No relationship is displayed by lower valence states. Since the range is much greater for intensity than energy in sulfur compounds of valence −2 or 0, it is speculated that the effects of unbonded electron changes are much greater on intensity than on energy. A plot of the relationship between the intensity and energy parameters, which is considered to be independent of the spectrometer employed, provides an empirical two-dimensional means of relating an uncertain chemical state of a sulfur atom to states that are better characterized. M.W.R.

N66-10724# Ethyl Corp., Baton Rouge, La. Research and Development Dept.
INVESTIGATION OF CHEMICAL VAPOR DEPOSITION OF BERYLLIUM FROM ORGANOBERYLLIUM COMPOUNDS Final Report, Jun. 1963–Jan. 1964
J. M. Wood, J. B. Chidester, and E. Dyble [1964] 16 p Prepared for Lawrence Radiation Lab., Calif. Univ.
(Contract W-7405-ENG-48)
(UCRL-13100)

An investigation was made of the vapor deposition of beryllium metal by pyrolysis of vaporous di-t-butylberyllium. The investigation includes a study of the effect of the more critical plating parameters, such as temperature, pressure, and flow rate on the properties and purity of the deposit. It is shown that a dense, continuous, adherent deposit can be produced from di-t-butylberyllium. The best results were obtained at a substrate temperature of 280° C to 305° C and at pressures of one torr or less. Plating rates of one mil per hour and efficiencies of 35 percent per pass were achieved. The coating is metallic gray in color, hard, and brittle, but not completely devoid of ductility. Chemical analysis of deposits indicate a minimum purity of 95 mole % beryllium metal, or 97 wt % beryllium. Principal impurities are beryllium carbide and hydride, and appear to be uniformly distributed throughout the deposit. The quality of the coating is equal to, if not better than, that produced by electrodeposition from organic media. C.T.C.

N66-10733# Georgia Univ., Athens. Dept. of Physics.
INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION Progress Report
W. C. Sears 8 Sep. 1965 21 p refs
(Contract AT(40-1)-2418)

Continued research conducted under a program designed to investigate changes in molecular structure produced by high energy radiation on different organic polymers, to determine the mechanisms of radiation induced growth and decay of unsaturation, and to determine changes in polymer crystallinity, crosslinking, and scission; is reported. Data on neoprene types, polyethylene, a proportional temperature controller, polybutadiene, polyurethane, and olefins, are presented. Studies of the infrared spectra of neoprenes before and after gamma irradiation showed that growth of trans-vinylene groups in neoprene during irradiation, as in polyethylene, is a zero-order process followed by first-order elimination. A proportional temperature controller was made to regulate the temperature of polymer films during spectroscopic measurements, and a paper written on the effect of radiation on the olefinic groups in polybutadiene. Assignments of bands for unirradiated Elastothane-455 were made. A gamma ray dose of 4.8×10^8 rads did not produce as much change in its spectrum as melting the film at 139.6 C. No indication of irradiation induced unsaturation was observed. S.C.W.

N66-10735# Georgia Univ., Athens.
THE INFRARED SPECTRA OF NEOPRENE BEFORE AND AFTER GAMMA IRRADIATION
Barry Hilton Moore (M.S. Thesis) 1965 40 p refs
(Contract AT(40-1)-2418)

The infrared spectra of neoprenes, types W, CG, and GN-M2, were measured, and vibrational assignments were made for the observed bands. A high degree of crystallinity was observed in type CG; a smaller degree in types W, and GN-M2. Gamma ray irradiation of type W at doses of 6.7×10^7, 2.5×10^8, and 8.7×10^8 rads; of type CG at 5.5×10^8 rads; and of type GN-M2 at 9.2×10^8 rads produced new bands at 965, 1243, and 1715 cm^{-1} together with shifting of the methylene stretching bands to higher frequencies. Formation of transvinylene unsaturation and crosslinking were the predominant effects; formation of methyl groups and double bond conjugation were also observed. It was concluded that transvinylene growth is a zero order reaction followed by first-order decay of transvinylene groups. Irradiation with doses higher than 2.5×10^8 rads eliminated crystallinity and crosslinking was postulated as the cause. It was determined that neoprene oxidized slightly in conjunction with irradiation, and that exposure to air greatly increased the oxidation of irradiated neoprene. Author

N66-10757*# Du Pont De Nemours (E. I.) and Co., Wilmington, Del. Engineering Physics Lab.
THE FORMATION AND PROPERTIES OF CERTAIN COMETARY SPECIES
G. J. Pontrelli Jan. 1965 78 p refs
(Contract NASw-707)
(NASA-CR-67626) CFSTI: HC $3.00/MF $0.75 CSCL 07E

Continuous- and flash-photolysis techniques have shown that, at wavelengths below 2500 Å., diacetylene decomposes to give C_2, C_3, and CH by radical-radical reactions. The implication of these results is discussed with relation to the mechanism of the radical formation at or near the nucleus of comets. The oscillator strengths for C_2 (Swan), CN (red), CO, CO^+, CO_2^+ have been determined. Author

N66-10789# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF PRODUCING ORGANOSILICON POLYMERS
V. B. Losev, S. V. Nadeyeva, and V. V. Astakhin 15 Jun. 1965 5 p Transl. into ENGLISH from Soviet Patent No. 161920 (Appl. No. 805094/23-4, 29 Nov. 1962) 1 p
(FTD-TT-65-194/1+4; AD-620126)

Method of producing organosilicon polymers through the interaction of aminosilanes and phenols is presented. TAB

N66-10797# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
THE OXIDATION OF PYROLYTIC GRAPHITE AT VARIOUS TEMPERATURES AND AIR VELOCITIES
Milton Levy and Philip Wong Jul. 1965 14 p refs
(AMRA-TR-65-18; AD-620005)

The oxidation kinetics of pyrolytic graphite was studied as a function of time, temperature, and air velocity. It was found that the oxidation of pyrolytic graphite is controlled by chemical activity below 1600F. At 1600F and above, the reaction is under diffusion control and the reaction rate is proportioned to the 0.4 power of the air velocity. Oxidation proceeded preferentially in the 'a' direction and is attributed to the weaker bonding between planes. Author (TAB)

N66-10803# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CRYSTALLIZATION OF SOLUTIONS UNDER THE EFFECT OF A HIGH VOLTAGE PULSE DISCHARGE
D. Ye. Glavatskiy, A. V. Kortnev, and A. N. Kutsenko 15 Jun. 1965 9 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii (Moscow), no. 2, 1964 p 147–148
(FTD-TT-64-1177/1+2+4; AD-620101)

The effect was investigated of a high voltage condensed spark discharge on the kinetics of crystallization of supersaturated aqueous solutions of tartaric acid. TAB

N66-10819# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USING PROPYLENE OXIDE AND ETHYLENE OXIDE BLOCK COPOLYMERS FOR DISINTEGRATION OF PETROLEUM EMULSIONS
D. N. Lebchenko, N. V. Nikolayeva, and A. D. Khudyakova 18 Jun. 1965 11 p refs Transl. into ENGLISH from Khim. i Teknol. Topliv i Masel (USSR), no. 3, 1964 p 36–40
(FTD-TT-65-323/1+2+4; AD-620077)

Conclusions: (1) Tested block copolymers have a deemulsification activity and can be recommended for deemulsification and desalting of crudes. (2) Most deemulsifying activity is possessed by block copolymers, obtained on the basis of propyleneglycol, in which the propyleneglycol part of the molecule was condensed from 60% ethylene oxide and the molecular weight is 1400–1800; a further increase in percentage of ethylene oxide reduces the effectiveness of the block copolymer. The ratio of molecular weight of oxyethyl groups to ocypropylene groups equals 3:2. For ethylenediamine base block copolymers, having high deemulsification activity, the ratio of the hydrophobic part of molecule (the polypropyleneglycol part of the molecule is called conditionally hydrophobic, although it possesses certain hydrophilic properties) to hydrophilic is 1.5. (3) Most effective with respect to the deemulsification effect block copolymers are not inferior to the best imported samples. Author (TAB)

N66-10822# Bureau of Mines, Pittsburgh, Pa.
FIRE AND EXPLOSION HAZARDS OF FLIGHT VEHICLE COMBUSTIBLES Quarterly Progress Report, Jun. 1–Aug. 31, 1965
J. M. Kuchta, G. H. Martindill, and I. Spolan 31 Aug. 1965 7 p refs
(Contract AF 33(615)64-1007)
(AD-620899)

The study was initiated to determine the ignition and flammability characteristics of titanium and its alloys in air and with various halogenated hydrocarbon fire extinguishing agents. The following fire extinguishing materials are included: bromochloromethan–CH_2BrCl, dibromodifluoromethane–CBr_2F_2, bromotrifluoromethane–$CBrF_3$, 1,1,1,-trifluorobromochloroethane–$CF_3CHBrCl$, 2,2,2 trifluoropentachloropropane–$CCl_3CF_2FCl_2$. Various halogenated hydrocarbon materials are known to be effective as fire extinguishing agents and are employed in current aircraft fire protection systems. The utilization of similar type agents is being considered for fire protection in advanced flight vehicles which make extensive use of titanium and its alloys. During the present report period, a literature search was conducted, necessary materials were acquitted for the initial experimental work, and test apparatuses were assembled and calibrated. In addition, ignition temperature type experiments were initiated with the fire extinguishing materials(vapors) in contact with heated titanium metal in air, nitrogen, and argon atmospheres. For convenience, the present experimental work is divided into two phases: (1) Autoignition experiments in heated vessels. (2) Experiments with electrically heated wires. Author (TAB)

N66-10834# United States Rubber Co., Wayne, N. J. Research Center.
PHOSPHONITRILIC POLYMERS STABLE AT HIGH TEMPERATURES Quarterly Report, May 1–Jul. 31, 1965
Douglas I. Relyea, Gerald J. Klender, and Aspet Merijanian 29 Aug. 1965 21 p refs
(Contract NObs-92060)
(QR-3; AD-621032)

The objective of this program is the development of new thermoplastic and thermosetting resins from phosphonitrilic chloride trimer for high-temperature insulation. Reactions of biamethylol-*o*-carborane or its disodium salt with $P_3N_3(OC_6H_5)_4Cl_2$(I) have given low-molecular weight polymers. *o*-Carborane was thermally isomerized to *m*-carborane for use in polymerizations with phosphonitrilic monomers. The preparation of I has been carried out on a large scale to give monomer for preparation of P-O-P-linked polymer. Monomer I was reacted with several aromatic diols and the resulting polymers examined by thermogravimetric analysis. Author (TAB)

N66-10865# General Dynamics/Convair, San Diego, Calif.
SPECTRAL EMISSIVITY MEASUREMENTS OF THE 4.3μ CO_2 BAND BETWEEN 2650° AND 3000°K
C. C. Ferriso, C. B. Ludwig, and L. Acton Aug. 1965 15 p refs
(Contract Nonr-3902(00))
(GD/C-DBE65-017; AD-620851)

Spectral emissivity measurements of the 4.3-μ CO_2 band were made at high temperatures. Under the conditions of the present experiments, the fine structure in the 4.3-μ CO_2 spectrum is smeared out and comparable with a weak line band model calculation. A comparison of the observed spectral emissivities with theoretical band model calculations shows good agreement. The measured integrated intensity of the 4.3-μ CO_2 band between 2650° and 3000° K is 2850 (cm^{-1}/per cm at STP) and agrees well with measured room temperature values. Author (TAB)

N66-10868# Groningen Rijksuniversiteit (Netherlands). Lab. of Physical Chemistry.
THE MAGNETIC TRANSITION IN WURSTER'S BLUE PERCHLORATE

Gerard T. Pott and Jan Kommandeur 29 Apr. 1965 9 p refs
(Contract AF 61(052)-729)
(SR-1; AFCRL-65-428; AD-620848)

A study was made of the magnetic transition in Wurster's Blue Perchlorate. From the spectroscopic and magnetic evidence it follows that the transition is due to a disproportionation of the tetra-methyl-p-phenylenediamine ion : TMPD (+) yields TMPD(++) + TMPD. Connected with this is a surprisingly high conductivity in the transition range. Author (TAB)

N66-10890# Hercules Powder Co., Wilmington, Del. Hercules Research Center.
A STUDY OF THE ELECTRONIC CONFIGURATION AND BEHAVIOR OF THE $-NF_2$ GROUP Quarterly Report No. 10, Jun.–Aug. 1965
Alan D. Craig 24 Sep. 1965 41 p refs
(Contract DA-31-124-ARO(D)-62; ARPA Order 402)
(HRC-65-3; AD-470652)

This report describes research in fundamental chemistry of the $-NF_2$ group. Efforts in the areas of electrochemistry, vibrational spectra, inorganic reactions, and dipole moment measurements have continued. The ground work for a correlation of observed electrochemical phenomena with molecular structure has been laid. The correlation relies heavily on molecular orbital calculations which are in progress. Author (TAB)

N66-10903# Joint Publications Research Service, Washington, D. C.
THE ELECTROLYTIC DEPOSITION OF THICK AND REGULINE RHENIUM LAYERS
I. M. Kvokova and V. I. Layner 9 Nov. 1965 10 p refs Transl. into ENGLISH from Zashchitn. Metallov (Moscow), v. I, no. 5, 1965 p 515–520
(JPRS-32773; TT-65-33351) CFSTI: $1.00

A good bonding is assured when relatively thick electrolytic deposits of rhenium are obtained in a reducing atmosphere at temperatures above 800° C. This is attributed to the formation of a rhenium-base diffusion alloy. The absence of a bond between the molybdenum or tungsten base and the rhenium coating, with thickness about 2 μ, is explained by cracks in the coating itself. The effect of chromium on the rhenium structure is to reduce the periods and volume of the lattice, indicating the formation of a solid substitution solution and development of vacancies. The rhenium–chromium alloy forms large and well-shaped crystals which are larger than those in the unalloyed rhenium deposit and which do not grow in proportion to the growth of the deposit. M.W.R.

N66-10912# Sacramento Peak Observatory, Sunspot, N. Mex.
THE SPECTROPHOTOMETRY OF LINES IN GRAINS OF CONTINUOUS EMISSION
A. B. Severny and V. L. Khokhlova 1963 9 p refs Transl. into ENGLISH from Izv. Krimskoi Astron. Obs. (USSR), v. 21, 1959 p 190–197
(T-11; AD-619159)

A spectrophotometric reduction of lines of neutral elements and some ions in the spectrum of grains of continuous emission was carried out. No noticeable difference between the behaviour of the neutral atoms and ions in the spectrum of the grain was noted. It is shown that the difference between the lines of the grain spectrum and those in the spectrum of undisturbed regions is explained satisfactorily when assuming the grains being optically thin formations localized at optical depths (in frequencies of the continuous spectrum) from grain number = 0 to approximately = 1. It is shown that the results of investigations of faculae cannot be explained by the averaging of the effect observed in the grains of continuous emission. Author (TAB)

N66-10923# American Oil Co., Whiting, Ind. Research and Development Dept.
SORPTION OF CARBONACEOUS FUELS AT ELECTRODES Final Report, Oct. 22, 1964–Jun. 15, 1965
R. J. Flannery, G. Aronowitz, and D. C. Walker Jul. 1965 77 p refs
(Contract DA-49-186-AMC-167(X))
(M65-181; AD-470983)

A technique for adsorption studies of organic fuels at electrodes by detecting C-14-labeled fuel through a thin-window electrode was developed. The method was applied to studies of n-butane adsorption and oxidation in 1N H_2SO_4 at sputtered Pt electrodes at 25° C. Adsorption is slow, requiring several hours to reach saturation. Saturation adsorption occurs at 0.3v (NHE) for butane concentration greater than 0.0002 molal and amounts to a fractional coverage of 0.39. Oxidation of butane at 0.3v leads to the formation of a strongly-held residue which will not desorb at 0.1v. Adsorption and oxidation of ethane, n-butane and n-octane were studied by a voltage step and galvanostatic pulse sequence on sputtered Pt electrodes in Mg_2SO_4 at 65° C. Temperature dependence was also sampled for ethane. Results indicate that these fuels are adsorbed in the potential range of 0.20 to 0.55v (NHE) and that the rate of build-up of surface species is dependent on both rate of fuel and adsorption and rate of oxidation. Oxidation rate parameters for ethane and n-octane are different from those for n-butane and the mode of adsorption appears to differ correspondingly. Author (TAB)

N66-10925# IIT Research Inst., Chicago, Ill.
INVESTIGATION OF THE ELECTROMAGNETIC PROPERTIES OF GARNET SINGLE CRYSTALS Technical Report, Mar. 1, 1964–Mar. 28, 1965
S. A. Marshall Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1965 91 p refs
(Contract AF 33(615)-1540)
(AFML-TR-65-153; AD-471868)

This report summarizes an experimental program concerning the electromagnetic properties of single crystal dielectric materials having the garnet structure. Work was chiefly concerned with studying the properties of isolated paramagnetic centers present as substitutional impurities in diamagnetic yttrium aluminum garnet. The complexity of the garnet structure and specifically the presence of 3 distinct cation sites each having oxygen coordination of a different symmetry enables a variety of ions from the 3d (n), the 5d (n) and the 4f (n) transition series to be examined and the influence of the local crystalline fields on their magnetic properties to be determined. The results reported were obtained chiefly using electron paramagnetic resonance absorption techniques supplemented by optical absorption and magnetic susceptibility studies. The ions investigated were tetrahedrally coordinated iron, octahedrally coordinated iron, chromium and cobalt, and dodecahedrally coordinated gadolinium and platinum. Author (TAB)

N66-10940# Battelle Inst., Frankfurt Am Main (West Germany).
STUDIES ON THE EFFECT OF NUCLEAR RADIATIONS ON HETEROGENEOUSLY CATALYZED GAS REACTIONS
Brussels, EURATOM, Aug. 1965 60 p refs
(Contract EURATOM-037-62-10 RISD)
(EUR-2455.e) CFSTI: HC $3.00/MF $0.50

Studies using various solid catalysts in the presence and absence of beta-radiation (Sr 90-Y 90, absorbed dose rate about 8.10^5 rad/h) were carried out on the decomposition of methanol, ethanol, isopropanol and formic acid, the hydrogenation of benzene and ethylene and the oxidation of carbon monoxide. Under the test conditions adopted the radiation was found to have no effect on the reaction rate and the type of reaction products. The results obtained from tests on heterogeneous catalysis in the presence of nuclear or ultra-violet radiation, which are available in the pertinent literature but are in some cases contradictory, indicate that the reason for the occurrence or absence of a radiation effect cannot be ascertained at the moment even in cases of a very similar nature. This is clearly due to the lack of knowledge on the radiation absorption mechanism in solids, especially near the surface. Author

N66-10946# Westinghouse Electric Corp., Pittsburgh, Pa.
DETECTION OF LIQUID CRYSTAL GASES (REACTIVE MATERIALS) Final Report, 1 Feb.–12 Nov. 1965
J. L. Ferguson, N. N. Goldberg, C. H. Jones, R. S. Rush, L. C. Scala et al Griffiss AFB, N. Y., RADC, Aug. 1965 128 p refs (Contract AF 30(602)-3306)
(RADC-TR-64-569; AD-620940)

A set of reactive liquid crystal materials were developed which are capable of detecting quantities (10 ppm or less) of HCl, HF, hydrazine, UDMH, and nitrogen dioxide. The materials exhibit a change in color transition temperature upon exposure to these contaminant gases of vapors. Except for HF and HCl, the contaminants are readily distinguished from each other. Author (TAB)

N66-10947# Holman (John F.) and Co., Inc., Washington, D. C.
LUMINOFOR BASED ON ZINC SULFIDE AND SENSITIVE TO INFRARED RADIATION [LUMINOFOR CITLIVY NA INFRACERVENE ZARENI, HA BAZI SIRNIKU ZINECNATEHO]
Rudolf Hradcovsky Fort Belvoir, Va., Army Engr. Res. and Develop. Labs., Sep. 1965 7 p Transl. into ENGLISH from Czechoslovak Patent Certificate No. 95316, 15 May 1960
(Contract DA-44-009-AMC-930(T))
(EDRL-T-1800-65; AD-620461)

The luminofor, activated by other metals for photographic registration in the infrared region, is distinguished by the facts that the zinc sulfide is free of deleterious metal impurities exceeding 1,000,000 percent by weight of the zinc sulfide, and is activated by copper, lead or cobalt, none of which may exceed 1000-10 to the 7th power percent of the zinc sulfide in either the activator or the flux used. This patent covers luminofor, a substance sensitive to infrared radiation in the spectral region up to 2500 microns in which infrared radiation is evidenced by extinction of phosphorescence. Author (TAB)

N66-10973# California Univ., Livermore. Lawrence Radiation Lab.
A THEORETICAL STUDY OF THE SECOND-ORDER RAMAN SPECTRA OF THE CESIUM HALIDES
J. R. Hardy, A. M. Karo, and I. W. Morrison 6 Sep. 1965 19 p refs
(Contract W-7405-ENG-48)
(UCRL-14398) CFSTI: $1.00

This report summarizes the results of recent calculations of the second-order Raman spectra of CsCl, CsBr, and CsI. For the last two crystals experimental results are available, and the calculations can be compared with the observed spectra. It is found that the spectra derived by allowing for the polarizability and overlap deformation of the ions are in much better agreement with the experimental results than those derived by treating the ions as rigid point charges. The probable reason for this agreement seems to be that the main peaks in the theoretical spectra arise from superpositions of critical points in the two-phonon dispersion curves which occur along symmetry axes. The present results tend to support the view that the observed Raman spectra provide a reasonably close mapping of the two-phonon density of states, and can be used both to test and refine theoretical calculations of the dynamical matrix. Also, if the computed spectra are reliable, it is apparent that low-temperature, high-resolution spectra should reveal considerably more detail than is currently available from room-temperature measurements. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N66-10097# Weapons Research Establishment (Australia).
STUDIES OF OPTIMUM STATION SITINGS IN DOPPLER TRACKING SYSTEMS. A NOTE ON THE ACCURACY TO BE EXPECTED OF A POLYSTATION FIX-FREE SYSTEM
A. E. Jordan Dec. 1963 42 p refs
(WRE-TN-SAD-132) CFSTI: HC $2.00/MF $0.50

Proposals for installing a re-designed Doppler tracking system at Woomera have been under consideration. In this report, best sitings are found for a system which is based on the conventional fix-dependent solution. A data-reduction method independent of fix-point is then described and best sitings are found for the extended lay-out of the receivers which would be required to provide the data. A practical arrangement to cover 250kft of the range is considered and detailed error contours for this system are shown. Recent findings concerning errors in Doppler path length measurements suggest that the detailed results of the method independent of fix-point should not be accepted without reservations. The nature of these errors is discussed. Author

N66-10105 Joint Publications Research Service, Washington, D.C.
COEFFICIENT OF ABSORPTION OF ELECTROMAGNETIC WAVES BY WATER VAPOR IN THE RANGE 10μ–2 cm
S. A. Zhevakin and A. P. Naumov *In its* News of Higher Educational Inst. 28 Feb. 1964 p 44–86 refs (See N66-10101 01-23) CFSTI: $6.00

Calculation has been carried out of the absorption of radiation in 10μ to 2 cm band by the atmospheric water vapor. The shape of lines has been obtained from the solution of the kinetic equation and half-widths of lines have been calculated by the use of Anderson's theory. Matrix elements of the direction cosines for the rigid asymmetrical top have been used; however, centrifugal perturbation was taken into account when calculating

the molecular terms of H_2O. The results are in good agreement with the experiment. Author

N66-10113 Joint Publications Research Service, Washington, D. C.
MODULATION OF SIGNALS IN TRANSMISSION LINES WITH PERIODICALLY VARYING PARAMETERS
L. A. Ostrovskiy *In its* News of Higher Educational Inst. 28 Feb. 1964 p 191–214 refs (See N66-10101 01-23) CFSTI: $6.00

The variation of the frequency and amplitude of waves propagating in a transmission line with time-varying parameters are considered. Data are presented on an experimental investigation of a parametric modulator, confirming the main deductions of the theory. Author

N66-10197# Litton Systems, Inc., Waltham, Mass. Information Sciences Lab.
STATISTICAL MODELS OF REVERBERATION AND CLUTTER, I
David Middleton 15 Apr. 1965 63 p refs
(Contract Nonr-3320(00))
(TR65-2-BF: AD-619515)

A general phenomenological, statistical model of reverberation and clutter, based on Poisson processes, is constructed, generalizing and extending earlier results, and taking into account many features of typical scattering mechanisms. These include transmitting and receiving arrays, doppler effects, broad- and narrow-band illuminations, distributions of scatterers on surfaces and in volumes, reflectivities, the geometries of transmitter, receiver, and scatterers, etc. A hierarchy of characteristic functions and associated probability densities is derived, with particular attention to the various classes of process covariances, which completely describe these processes when the scattering events are sufficiently dense that normal laws are obeyed. These processes are found to be inherently nonstationary, because of the distributed nature of the scattering elements, although quasi-stationarity may occur if illuminating signals of sufficiently short duration are used. The results are generally applicable to radar, sonar, and seismic problems, particularly when the distributed nature of the scattering mechanisms and ths space-time processing features of the receiving and transmitting spectrum must be explicitly considered. Author

N66-10211# Joint Publications Research Service, Washington, D. C.
SOVIET-BRITISH TESTS WITH USW SPACE RADIO COMMUNICATIONS
I. M. Puzyrev 18 Oct. 1965 10 p Transl. into ENGLISH from Zemlya i Vselennaya (Moscow), no. 4, Jul.–Aug. 1965 p 58–62
(JPRS-32442; TT-65-32931) CFSTI: $1.00

A series of experiments dealing with space radio communications were conducted. Among the areas mentioned are: Echo-2, the Jodrell Bank Transmitter, the Zimenki Receiver, forms of space radio communication, and an investigation into the possibility of using the moon for the Echo-2 in the transmission of signals which were successfully relayed via the artificial satellite. R.W.H.

N66-10212# Joint Publications Research Service, Washington, D. C.
THEORY OF OPTIMUM METHODS OF RADIO RECEPTION DURING FLUCTUATING NOISES
L. S. Gutkin 22 Oct. 1965 452 p refs Transl. into ENGLISH of the book "Teoriya Optimal'nykh Metodov Radiopriyema pri Fluktuatsionnykh Pomekhakh" Moscow, State Power Publ. House, 1961 p 2–484
(JPRS-32514; TT-65-32993) CFSTI: $7.50

The theory of optimum methods for receiving signals in a background of fluctuating noise is examined. The theory of potential noise immunity, and an analysis of certain assumptions of this theory are briefly considered. Optimum reception is examined for signals which are precisely known and for signals which contain several unknown (random) parameters. An analysis is made of optimum receivers and their properties by contemporary mathematical statistical methods. C.T.C.

N66-10218# Oklahoma Univ., Norman. Graduate College.
THE FIELD INTENSITIES IN A SECTORAL HORN ANTENNA
Gary Lee Seasholtz (M.S. Thesis) 1965 46 p refs
(Contract AF 33(608)-1096)
(AD-620386)

Equations for the field intensities in a rectangular waveguide and a radical waveguide are derived. From these equations, the field intensities in the aperture of an E plane sectoral horn joined to a rectangular waveguide are derived for both the finite and infinite cases. TAB

N66-10231* Radio Corp. of America, Princeton, N. J.
THE MICROWAVE REPEATER
J. Kiesling, H. R. Mathwick, T. Wakefield, W. Wilkinson, and I. E. Podraczky *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 91–127 refs (See N66-10226 01-31)
GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1272)

A dual-mode, active heterodyne repeater was designed and successfully tested in connection with Project Relay, which was concerned with providing a high quality communications link to experimentally verify the feasibility of microwave communications via an active spacecraft repeater. Repeater function and the basic design configurations are discussed, and a summary of performance requirements is tabulated. Details are presented for the microwave antenna and receivers. Basic requirements, major characteristics, and environmental considerations for the traveling wave tube are discussed. Fabrication procedures are given and the test program is presented for the TWT; the effect of refocusing during aging on helix current is shown; and the TWT power supply parameters are given. The repeater was swept in frequency in both wideband and narrowband modes to insure that receiver bandpass characteristics were adequate and not a function of signal level. The largest spurious output in both modes was observed at 4193 Mc and was 36 db below the carrier. This is the 37th harmonic of the beacon crystal frequency. M.W.R.

N66-10232* Radio Corp. of America, Princeton, N. J.
THE TELEMETRY SYSTEM
E. Mozzi and S. Roth *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 129–152 (See N66-10226 01-31)
GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1272)

Design and operation are considered for the signal conditioner, telemetry encoder, telemetry transmitter, and antenna for the Relay I telemetry system. Relay I telemetry channel allocations are tabulated and performance characteristics and reliability are discussed for the encoder which uses solid state circuitry. The development program, flight model program, and system for the transmitter is presented; and sensitivity of

the transmitter was reduced to provide a compatible system. Maximum frequency variations for Project Relay telemetry transmitters are tabulated. Design requirements, problems encountered, and a performance evaluation are included for the TT&C (two transmitters and a 3-db coupler) antenna system.
M.W.R.

N66-10233* Radio Corp. of America, Princeton, N. J.
THE COMMAND SYSTEM
S. Roth, H. Goldberg, and J. Blair *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 153–169 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1272)

Ground transmitted commands and internal logic functions are described for the Relay I command system. The 20 direct commands and their respective control circuit outputs are tabulated; three of the commands each require the accomplishment of two functions. The command receiver, which is required to receive, amplify, and demodulate coded ground station instructions, is discussed in terms of design approach, parameters, packaging, and environmental testing. Command demodulator and decoder equipment was developed to demodulate the tone bursts which contained the coded messages, convert the pulse-duration modulation into a binary code, and decode the messages into the twenty discrete commands required for command system functioning. The control box input channels and other signals are described, and packaging and testing are mentioned.
M.W.R.

N66-10239* Space Technology Labs., Inc., Redondo Beach, Calif.
THE RELAY EXPERIMENT PLAN
R. Cagnon *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 275–287 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1302)

Wideband, narrowband, multiplex, and one-way noise loading capabilities of ground stations participating in Project Relay are summarized; and the various communications experiments performed are described. Categories for these experiments include: (1) received carrier power and insertion gain, (2) noise measurements, (3) linear distortion, (4) nonlinear distortion, and (5) special transmission tests. Television test patterns provide a basis for subjective evaluation of the TV system performance; and system demonstration tests indicate the feasibility of satellite communications for television, telephony, digital data, teletype, and facsimile transmission.
M.W.R.

N66-10241* Space Technology Labs., Inc., Redondo Beach, Calif.
THE RELAY TEST STATION LOW NOISE RECEIVING AND DEMODULATION SYSTEMS
R. S. Eastman and R. A. Miller, Jr. *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 329–358 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1302)

The wideband FM receiving subsystems in use at the NASA Goddard Relay Test Stations are similar in design except for the antennas. Descriptions are presented of the equipment, with special attention directed to the theory of operation and performance data of the 4 Gc, liquid nitrogen cooled, parametric amplifier and wideband phase-lock demodulator. System noise temperatures of 100°–125° K have been measured in accordance with performance objectives. Threshold improvement of 5 db over that of a conventional discriminator has been demonstrated by the use of the phase-lock demodulator.
Author

N66-10242* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELAY SYSTEM OPERATIONS
D. E. Kendall (Space Technol. Labs.) and W. S. Sunderlin *In its* Relay I Program 1965 p 359–382 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

This paper discusses the operational aspects of Relay with respect to the techniques used in operating the spacecraft in orbit and the experience acquired during the in-orbit operation. A description is given of the Relay Operations Center and its functions, including the support communications network of telephone, teletype, and video monitor links that were required for effective control of the satellite and coordination of operations. The requirements for satellite command and for real-time telemetry data reduction and evaluation are outlined, and a description is given of the system used to meet these requirements. Examples are given of how the system was applied to specific operational situations. The operation of the satellite involved the issuance of operational plans that provided for scheduling of communication experiments and of station participation. A discussion is given of the basis for scheduling, such as selection of specific orbit revolutions for stations and experiments on the basis of mutual visibilities, slant ranges, spacecraft look angles, ground antenna elevation angles, eclipses, and spacecraft duty cycle. The effect of precession of the orbit on mutual visibilities is also discussed.
Author

N66-10243* Radio Corp. of America, Princeton, N. J.
SPURIOUS SIGNALS IN SATELLITE COMMAND SYSTEMS
J. C. Blair *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 383–402 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1272)

Problems encountered during operation of the Relay I command system are generalized for a discussion of spurious signals in satellite command systems. An analysis is made of the command system; and the command control box and a list of commands are considered. Error probabilities are computed for the two basic types of command errors in a system such as Relay: (1) failure to effect the desired command and (2) occurrence of commands which are not actually transmitted. Receiver noise density and power calculations are made. Since spurious commands became a serious problem during the orbit of Relay I, a performance analysis of its command system was undertaken. Spurious commands were tallied for the 20 commands given the Relay spacecraft, and various laboratory tests and a command decoder investigation were made. It is emphasized that interfering signals must be considered a basic problem which any command system will encounter. Secure command systems can result from increased complexity in operational procedures; command signal squelching with improper signal recognition is the technique employed in the Relay II program.
M.W.R.

N66-10248* Bell Telephone Labs., Inc., Murray Hill, N. J.
COMMUNICATIONS EXPERIMENTS CONDUCTED AT ANDOVER, MAINE
R. E. Blatz *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 477–514 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1987)

Communications tests conducted on the Relay I satellite, based on data taken at the Andover test station, were found to be in good agreement with theoretical values. Many of the tests were conducted on a loop basis, from Andover to the

satellite and back to Andover. The ground station communications system is described and diagrammed as is multiplex system equipment. Data and measurements are discussed for received carrier power, baseband transmission, noise, and nonlinearity. Typical photographs of television test patterns are included which were used to evaluate the overall transmission characteristics of the satellite system. Both feedback and standard FM receivers were used. Two-way telephony performance was evaluated with measurements from widely separated stations; and tabulations are presented for insertion gain, baseband loop noise, satellite noise, and intelligible crosstalk. M.W.R.

N66-10250* ITT Federal Labs., Nutley, N. J.
RESULTS OF RELAY I NARROWBAND EXPERIMENTS
In NASA. Goddard Space Flight Center Relay I Program 1965 p 525–545 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-2056)

Narrowband experiments were performed for Relay I to determine the extent to which a theoretical communications system can meet performance requirements. The twelve experiments undertaken while the spacecraft was in orbit are listed along with the number of times each was performed. For example, received carrier power was tested 645 times; continuous random noise, 141; insertion gain, 70; and intelligible crosstalk, 6. Detailed analyses are included for intermodulation distortion tests, system threshold with and without extension, and spacecraft noise figure in narrowband mode. A near-zenith tracking experiment is also discussed. It is demonstrated that the two-tone harmonic performance test provides a means for separately predicting the contributions of amplitude and phase nonlinearities to noise intermodulation. Measured and calculated values of signal-to-noise ratio are in good agreement; measurement of satellite noise indicates degradation of about 2 db from prelaunch values. M.W.R.

N66-10251* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GSFC DEMONSTRATIONS
G. Bullock *In its* Relay I Program 1965 p 549–559 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

Television, facsimile, teletype, voice, and special demonstrations were made by the various ground stations during the flight of Relay I. Photographs are included for some of the demonstrations, and all of the demonstrations performed are tabulated. M.W.R.

N66-10254* Centre National d'Etudes des Telecommunications, Issy les Moulineau (France).
RESULTS OF TESTS PERFORMED WITH RELAY I AT THE PLEUMEUR-BODOU SPACE COMMUNICATIONS STATION
L. Bourgeat, A. Dyevre, and J. P. Houssin *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 597–632 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

A description is given of the tests performed at the French satellite communications station at Pleumeur-Bodou with the Relay I satellite. An analysis is given of the means for acquiring and tracking a satellite and of the characteristics of the resulting communication link. The tests were extremely satisfactory and provided the experience necessary for the commercial exploitation of future satellite communication links. Author

N66-10256* Deutsche Bundespost, Darmstadt (West Germany).
RESULTS OF TESTS PERFORMED WITH RELAY I AT THE RAISTING SPACE COMMUNICATIONS STATION
E. Dietrich et al *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 641–645 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

Narrowband tests performed with Relay I at the Raisting space communications station in Germany were concerned with insertion gain stability, continuous random noise, amplitude-frequency baseband, intelligible crosstalk, two-way telephony, and teletype and facsimile transmission. Positions of Relay I during the experiments are tabulated as is an evaluation of teletype transmission. M.W.R.

N66-10257* Telespazio, S.p.A., Rome (Italy).
DESCRIPTION AND RESULTS OF TESTS PERFORMED AT FUCINO EARTH STATION WITH RELAY I
P. Fanti et al *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 647–655 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

Communications and tracking facilities of the Fucino space communications ground station in Italy are described, and results are given for experiments with the Relay I performed there. Received carrier power and narrowband and wideband experiments are reported. Baseband characteristics, continuous random noise, noise loading, harmonic performance, and insertion gain test results are presented for the narrowband. Although the Fucino station is not designed for wideband installation, certain TV test signals and demonstrations were received; only under particularly favorable conditions was reception above the threshold. A phase lock demodulator was found to give better pictures than a standard video demodulator. Effects of a sync restorer and some photos are shown. M.W.R.

N66-10259* Kokusai Denshin Denwa Co., Ltd., Tokyo (Japan).
RESULTS OF TESTS PERFORMED WITH RELAY I AT THE KDD SPACE COMMUNICATIONS STATION
In NASA. Goddard Space Flight Center Relay I Program 1965 p 663–670 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

Results are summarized for wideband receiving experiments performed with the Relay I satellite at the Kokusai Denshin Denwa space communications station. Although recordings were taken over a relatively short period of time, several conclusions are drawn from the resultant data. Transmission characteristics of satellite-borne Relay instruments and the ground-based receiver were found to be fairly good. Received power was found to fluctuate within a range of −91 to −94 dbm; random noise values varied in range from 43 to 46 db and satisfied the reference value of 43 db. Quality of TV video was, in general, fairly good, although audio signals were not very good. M.W.R.

N66-10261* General Post Office, London (England).
RESULTS OF TESTS PERFORMED WITH RELAY I AT THE GOONHILLY DOWNS SPACE COMMUNICATIONS STATION
W. J. Bray, F. J. D. Taylor, and R. W. White *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 753–767 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

Results of tests performed with Relay I at the Goonhilly Downs ground station confirm expectations that active communications satellites can provide high-quality stable circuits

for television, multi-channel telephony, video frequency telegraphy, and facsimile picture transmission. Very good results were obtained in tests with 600 simulated telephone channels. Propagation tests indicate the possibility of reliable operation with elevation angles of only a few degrees. At no time has interference from either radio-relay systems sharing the same frequency band or other man-made sources been detected on the satellite link. Satellite tracking has been accomplished to within ten minutes of arc from orbital data predicted up to a fortnight in advance and with automatic fine correction to within a minute or two of arc. M.W.R.

N66-10323*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EQUIVALENT NOISE BANDWIDTH ANALYSIS FROM TRANSFER FUNCTIONS
Thomas J. Karras Washington, NASA, Nov. 1965 45 p refs (NASA-TN-D-2842) CFSTI: HC $2.00/MF $0.50 CSCL 17B

This report clarifies the terms "equivalent noise bandwidth" (ENBW), "natural frequency" (ω_0), and "3 db bandwidth" (ω_{3db}), and demonstrates the relationships between these terms and the network transfer function. Two methods for calculating the ENBW from a filter transfer function are described. In illustration of these methods, three filters are analyzed. They are: (1) first order (Type 0) passive low pass filter, (2) second order (Type 1) phase lock loop tracking filter, and (3) third order (Type 2) phase lock loop tracking filter. Each of these filters possesses an attenuation characteristic of -6 db/octave at $\omega > 10\omega_0$. A comparison is made of the ENBW for a second order (Type 1) and third order (Type 2) phase lock loops, as a function of the damping factor (ξ). Author

N66-10343*# Jet Propulsion Lab., Calif. Inst of Tech., Pasadena.
GEOMETRIC ASPECTS OF GROUND STATION/SATELLITE COMMUNICATIONS
Roger D. Bourke 15 Oct. 1965 17 p refs
(Contract NAS7-100)
(NASA-CR-67717; JPL-TR-32-820) CFSTI: HC $1.00/MF $0.50 CSCL 17B

This report presents a discussion of the geometric aspects of communications between a ground station and a satellite in an elliptic orbit whose line of apsides is fixed. The range to the satellite along a given vector from the ground station is shown to take on, at maximum, two values; a means for calculating these values is presented. In addition, an averaging method is used to develop an expression for the long-term fraction of time a satellite and ground station are covisible. Applications of these results to various communications satellites and ground stations are shown. Author

N66-10377# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF COMBINING OPTICAL TRANSMITTING AND RECEIVING TRACTS OF LIGHT RANGE FINDERS
G. A. Fel'dman 11 Aug. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 146503 (Appl. no. 722648/26-10, 21 Mar. 1961) 2 p
(FTD-TT-65-210/1+2+4; AD-619454)

The object of the invention is a method of combining transmitting and receiving optical tracts of light range finders, employing modulators, based on phenomena of artificial anisotropy, e.g. Kerr cells, distinguished by the fact, that for the purpose of creating light range finders, having one receiving-transmitting optical system, the receiving and transmitting light beams on it are polarized in mutually perpendicular planes and are divided with the aid of a bipolarizing arrangement. Author(TAB)

N66-10381*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHORT-TERM FREQUENCY STABILITY
Washington, NASA, 1965 296 p refs Proc. of IEE-NASA Symp. on the Definition and Meas. of Short-Term Freq. Stability, Greenbelt, Md., 23–24 Nov. 1964
(NASA-SP-80) GPO: $1.75; CFSTI: MF $1.50 CSCL 09F

Symposium papers on the definition and measurement of short-term frequency stability are presented. For individual titles see N66-10382–N66-10407.

N66-10382* Hughes Aircraft Co., Culver City, Calif.
SHORT-TERM STABILITY FOR A DOPPLER RADAR: REQUIREMENTS, MEASUREMENTS, AND TECHNIQUES
D. B. Leeson and G. F. Johnson *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 7 p (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

Short-term frequency stability is an important parameter affecting resolution and range of a Doppler radar. This paper describes system and circuit requirements found in a typical airborne Doppler radar designed for operation in a severe vibration and acoustic environment. The characteristic of a Doppler radar which leads to short-term stability requirements is its use of a narrow-band receiver to detect a Doppler-shifted target return which is weaker than clutter. Short-term stability for a Doppler radar is defined in terms of linewidth and spectrum. Oscillator and crystal requirements are derived from the system requirements. Measurements of linewidth and spectral purity under quiescent and environmental conditions are described, and vibration characteristics of quartz crystals are considered. Author

N66-10383* Raytheon Co., Bedford, Mass.
BASIC RELATION BETWEEN THE FREQUENCY STABILITY SPECIFICATION AND THE APPLICATION
J. D. Hadad *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 7 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

This paper classifies the requirements for short-term stability according to the application by examining applications ranging from velocity and acceleration measuring devices to coherent radars exposed to clutter. FM noise is generated at substantially different levels in typical sources, and the effect of each is different as it affects performance and influences equipment design. FM noise is considered with respect to either the requirement or the accuracy of a measurement. Author

N66-10384* Westingnouse Electric Corp., Baltimore, Md.
MASTER OSCILLATOR REQUIREMENTS FOR COHERENT RADAR SETS
L. P. Goetz and W. A. Skillman *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 9 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

Stability requirements for pulse Doppler MTI radars which operate in a severe clutter environment are derived on the basis of required performance. Performance factors considered are spurious generation, signal loss, ranging, and lobing noise. Requirements are shown to be different for common modulation, where the range time delay modifies phase relations, and for independent modulation, where no delay is involved. A stability requirement given in parts per million is seen to be inadequate; rather, a more complex "deviation spectrum" is required. A typical state-of-the-art radar is postulated, and its requirements are calculated. Author

N66-10385* Raytheon Co., Wayland, Mass.
COHERENT RADAR FM NOISE LIMITATIONS
D. M. Raduziner and N. R. Gillespie *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 10 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

The fundamental benefits of coherent radar are compromised by uncontrolled deviations in transmitted phase or frequency. An example illustrating the dependence of an adequate definition of short-term frequency stability on spectral content considerations is given, followed by a brief review of techniques employed to generate and measure short-term frequency stable sources for coherent radars. Illustrations are provided to compare the test data obtained from a klystron microwave exciter and an all solid-state microwave source which employs a piezoelectric crystal oscillator, transistor amplifiers, and varactor frequency multipliers. A practical problem is illustrated by experimental results obtained when the performance of the above microwave sources in a vibration environment are compared. Finally, a brief comparison of the operation of two coherent radar processors in the presence of unwanted FM discloses an interesting difference in clutter rejection degradation. Author

N66-10386* TRW Systems, Redondo Beach, Calif.
SATELLITE RANGE AND TRACKING ACCURACY AS A FUNCTION OF OSCILLATOR STABILITY
J. J. Caldwell, Jr. *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 3 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

Guidance, tracking, and communication requirements of earth satellites and space systems often demand high-stability oscillators. Some system types need high-order short-term, yet modest long-term, stability. In other systems emphasis must be placed on long-term stability with short-term stability playing a minor role. Under other circumstances stability over a wide range of observation periods must be considered. Systems of each type are briefly examined, and the effect of oscillator stability on system performance is discussed. Author

N66-10387* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SHORT-TERM STABILITY REQUIREMENTS FOR DEEP SPACE TRACKING AND COMMUNICATIONS SYSTEMS
R. L. Sydnor *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 8 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50
(Contract NAS7-100)

The use of phase-locked receivers in unmanned deep space exploration requires a high degree of phase stability in the transmitter and receivers used in the Deep Space Network. Present requirements are based on available transmitter power, receiver noise temperature and range of planned targets, as well as required accuracy of measurements. The requirements are for the system phase noise, as measured in a double-sided noise bandwidth of 5 cps, to be less than 0.2 radian rms at S-band. The actual performance of an operational S-band system has been measured as less than 0.05 radian rms. Requirements and performance of a developmental X-band system are described. Correlation techniques using a digital data handling system on line have been used for extreme range experiments. This system is used for planetary and lunar mapping experiments and is applicable to extreme range, low-bit-rate telemetry and communications. Several methods of measuring short-term stability are used, depending on the final requirements of the system and the use to which the system will be placed. These methods are discussed in detail, and representative data are presented. Author

N66-10388* ADCOM, Inc., Cambridge, Mass.
SHORT-TERM FREQUENCY STABILITY: CHARACTERIZATION, THEORY, AND MEASUREMENT
E. J. Baghdady, R. N. Lincoln, and B. D. Nelin *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 23 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

An analysis of the manner in which oscillator short-term instabilities limit performance in a number of applications is presented. This analysis provides guidelines for theoretical formulations, the definition of *short-term stability*, and the development of measurement techniques for characterizing short-term instabilities. The factors that affect short-term stability are discussed, and basic models for theoretical analysis are formulated. The models are used in investigations of the characteristics of outputs of "stable" sources. Measurement techniques are proposed and compared with techniques employed by other investigators. Author

N66-10390* Curry, McLaughlin and Len, Inc., Syracuse, N. Y.
SPECIFICATION OF SHORT-TERM FREQUENCY STABILITY BY MAXIMUM LIKELIHOOD ESTIMATES
T. F. Curry *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 9 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

This paper presents a fundamental basis for interpreting and processing measured short-term frequency stability data. This approach evolved from a need for quantitatively describing the short-term stability of microwave signal sources over microsecond-to-second time intervals in a reproducible fashion and from a desire to explain observed differences in the measured stabilities of such sources in terms of various hypotheses concerning the nature of the noise mechanisms which produce the measured phase or frequency fluctuations. The particular approach described here was suggested by a paper by Slepian. Author

N66-10396* ITT Federal Labs., Nutley, N. J.
MEASUREMENTS OF SHORT-TERM FREQUENCY STABILITY USING MICROWAVE PULSE-INDUCED EMISSION
M. Arditi *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 11 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

Measurements of short-term frequency stability of microwave signals can be simplified if a source of good short-term stability can be used for comparison. Microwave pulse-induced emission in the alkali vapors can provide such a signal for periods of 10 to 20 msec. The short-term frequency stability of such a signal in a rubidium gas cell has been measured at 6834 Mc by beating two nearly identical gas cells against each other. A photographic method was used to measure the period of the beat frequency over periods of time of a few milliseconds. The results of the measurements show that the short-term frequency stability was as good, or better, than the resolution of the method—in this case: 1 part in 10^9 for periods of measurement of 1 millisecond. The microwave pulse-induced emission signal from the rubidium cell also was used to measure the short-term frequency stability of microwave signals produced from crystal oscillators and varactor harmonic generators. The results of the tests indicate that such signals can be relatively free of phase instability, even for such large multiplication factors. Author

N66-10400* Raytheon Co., Bedford, Mass.
STABILITY MEASUREMENT TECHNIQUES IN THE FREQUENCY DOMAIN

R. A. Campbell *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 5 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

The general art of demodulating RF signals has been practiced for many years, but this art becomes more difficult when the information to be extracted is oscillator noise—especially when an accurate quantitative measurement is desired. This paper surveys the general subject of time versus frequency domain measurements and investigates the frequency domain more thoroughly. The paper is largely devoted to CW frequency demodulators used in noise measurements. Comparisons are made with respect to sensitivity, equipment noise, power levels required, and rejection of other modulation modes. Varied aspects of postdetection equipment are also considered, especially video filter noise bandwidths and current attempts to standardize bandwidth to facilitate establishment of a noise specification. A brief discussion of the various types of readout devices (oscilloscopes, voltmeters, etc.) is included. Calibration—both direct and indirect—is discussed, along with the applicability of the various methods available. Author

N66-10401* Syracuse Univ. Research Corp., N. Y.
SHORT-TERM STABILITY MEASUREMENT TECHNIQUES AND RESULTS
R. H. Holman and L. J. Paciorek *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 16 p ref (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

In applications where there is a need for short-term frequency stability or spectral purity in microwave sources, we have found it practical to measure this property by means of spectral plots and by fine discrimination techniques. Frequency variations which occur over periods of less than 1 millisecond to about 1 second have been of major concern. Four techniques (including the traditional short-term stability measurement) used to measure short-term perturbations or noise in a source are described, and the relations existing are discussed. The technique using a spectral plot or wave analysis is the one primarily used; and typical measurement results on the outputs of devices such as a crystal frequency standard multiplier chains a traveling wave tube (TWT) and the helium–neon (He–Ne) gas laser are shown. Author

N66-10403* Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
SHORT-TERM STABILITY MEASUREMENTS IN THE SURVEYOR SPACECRAFT SYSTEMS
B. E. Rose *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 3 p (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50
(Contract NAS7-100)

The telecommunications link for the Surveyor Spacecraft utilizes a receiving and transmitting link at a frequency of approximately 2200 Mc. Both the spacecraft and the ground station use phase-lock loop receivers. To prevent loss of phase lock due to vibration caused by the vernier engine and retro engine burning and the landing shock, the transmitter and receiver must meet short-term stability requirements, expressible as a maximum phase jitter of 45 degrees, peak-to-peak, measured in a phase-locked loop of 425-cps noise bandwidth, under conditions of 3 g's zero-to-peak vibration from 10 cps to 10 kc. Measurements of phase jitter in the oscillator modules are presented in the report, and the method of measurement is discussed. Excessive phase jitter was found to occur at approximately 400 cps in the transmitter and 1100 cps in the receiver. These frequencies were found to be the crystal-mount mechanical resonant frequencies for the HC-18/U (transmitter) and HC-6/U (receiver) crystals. Two methods for reduction of phase jitter are described: The first utilizes a foam vibration isolation mount, and the second used a component with a greatly improved internal mounting structure for the quartz plate. Author

N66-10404* Hewlett-Packard Co., Palo Alto, Calif.
SHORT-TERM STABILITY MEASUREMENTS
V. Van Duzer *In* NASA. Goddard Space Flight Center Short-term Freq. Stability 1965 4 p (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

The short-term stability of a signal can be specified by a limit plot of phase noise and spurious signals versus frequency-of-offset plot. Such a specification will allow evaluation and comparison of signals for a particular application with appropriate system band-limiting, etc. This paper deals with the physical measurement techniques used to obtain such data for high-quality signal sources. A low-noise double-balanced mixer, a low-noise amplifier, a low-frequency wave analyzer, and similar signal sources are the elements of such a system. The measurement capability here should be about 160 db relative per root cycle, or something better than $\Delta f/f$ of 4×10^{-13} for 1-second averaging with 30-kc bandwidth of 1 Mc. This technique is readily extended to the measurement of the short-term stability of resonant devices and signal-processing circuitry. Some aspects of practical measurement experience in connection with a high-quality frequency synthesizer are presented. Author

N66-10405* Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
COMPUTER-AIDED CALCULATION OF FREQUENCY STABILITY
C. L. Searle, R. D. Posner, R. S. Badessa, and V. J. Bates *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 5 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50
(Contract DA-36-039-AMC-03200(E))

The autocorrelation of the phase difference between two oscillators can be readily calculated on a computer, and the resulting function can be converted very easily to any of the usual methods of specifying frequency stability. This paper reviews briefly the relations between the autocorrelation of the phase information and various methods of specifying frequency stability. Then we discuss an experiment currently underway which uses this method to find the frequency of two oscillators. Author

N66-10417*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE RANGER III FLIGHT PATH AND ITS DETERMINATION FROM DATA
W. L. Sjogren 15 Sep. 1965 133 p refs
(Contract NAS7-100)
(NASA-CR-67698; JPL-TR-32-563) CFSTI: HC $4.00/MF $1.00 CSCL 17I

This Report describes the *Ranger III* tracking data obtained from the Deep Space Instrumentation Facility (DSIF) and the way in which these data were used to determine the spacecraft's orbit. The data are presented in the form of residual plots (i.e., the difference between the actual observed data and theoretical calculated data), and the resulting spacecraft orbit parameters are displayed in summary tables and the Orbit Determination Program (ODP) computer printout. *Ranger III* executed a maneuver approximately 13 1/2 hr from launch but missed the Moon by about 35,000 km because of booster-guidance errors. Its transmitter continued operating for another four days. Good tracking data were obtained both prior to and after the maneuver, which have given an estimate on

the universal gravitational constant times the earth's mass as well as the spacecraft's position and velocity. Author

N66-10421*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LARGE ANTENNA APERTURES AND ARRAYS FOR DEEP SPACE COMMUNICATIONS
Philip D. Potter, William D. Merrick, and Arthur C. Ludwig 1 Nov. 1965 31 p refs
(Contract NAS7-100)
(NASA-CR-67666; JPL-TR-32-848) CFSTI: HC $2.00/MF $0.50 CSCL 17B

Three considerations relating to antennas for deep space communications are treated in detail: (1) the economic balance between large ground antenna apertures and potential spacecraft improvements, (2) the best method of implementing large apertures as a function of size, and (3) the optimum frequency of operation. To answer these questions this Report concentrates on economics, because there do not appear to be any serious technical problems that cannot be obviated by proper design of the ground station. Three conclusions are firmly established: (1) equivalent apertures, large compared with that of a 200-ft-diam class paraboloid, are very expensive and not economically warranted for another 10 to 15 years, at which time a manned planetary exploration program may exist; (2) either a steerable paraboloid of approximately 200-ft diameter or an array of these antennas is the ideal type of aperture implementation; and (3) within the present state of the art in structural design the optimum frequency of operation is approximately 2 Gc/s—however, a significant improvement in structural techniques could make the 4 to 6 Gc/s band more attractive. Author

N66-10422*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-55, VOLUME III FOR THE PERIOD JULY 1, 1965 TO AUGUST 31, 1965 THE DEEP SPACE NETWORK
30 Sep. 1965 80 p refs
(Contract NAS7-100)
(NASA-CR-67728; JPL-SPS-37-35, Vol. III) CFSTI: HC $3.00/MF $0.75 CSCL 09F

Work is reported on the Deep Space Network (DSN) which is a precision system designed for communication with and control of deep space exploration spacecraft. Included are summaries concerning development of antenna engineering and a spacecraft visibility program for tracking stations operations; a simulation data conversion center for the space flight operations facility; S-band implementation for the instrumentation facility; and a brief discussion of several communications devices under investigation. G.A.L.

N66-10437# United Kingdom Atomic Energy Authority, Harwell (England). Electronics Div.
A METHOD OF GAIN SWEEPING FOR SINGLE CHANNEL PULSE-AMPLITUDE ANALYSIS
D. Williams London, HMSO, Jun. 1965 11 p refs
(AERE-R-4961)

Problems associated with various methods of gain sweeping are discussed. A method of single channel pulse amplitude analysis is described which allows gain sweeping to be used without the poor time utilization of the linear sweep display or the difficulties of energy calibration associated with the logarithmic energy approach. The method of obtaining an exponential sweep by means of an integrating motor and potentiometer has been shown to perform satisfactorily. An improved dynamic range could be obtained in an engineered version, since frictional losses in the gearing could be reduced and the effective output impedance of the potentiometer lowered. The exponential sweep could also be obtained by applying an electronically generated waveform to the X input of an X-Y plotter. However, the electromechanical method has the advantage of simplicity, particularly in the maintenance of a precise linear energy calibration. R.N.A.

N66-10515# Resdel Engineering Corp., Pasadena, Calif.
THEORY OF PHASELOCK TECHNIQUES
Floyd M. Gardner, Steven S. Kent, and Raymond D. Dasenbrock [1965] 260 p refs
(REC-TR-22A)

The mathematics and network theory needed for understanding phaselock principles are summarized, and fundamental equations for the basic loop are derived. The phase detector compares the phase of a periodic input signal against the phase of the voltage controlled oscillator (VCO); output of the phase detector (PD) is a measure of the phase difference between its two inputs. The difference voltage is filtered by the loop filter and applied to the VCO. Control voltage on the VCO will change the frequency in such a direction as to reduce the phase difference between the input signal and the local oscillator. To maintain the control voltage needed for lock, it is generally necessary to have a non-zero output from the PD. Consequently, the loop operates with some phase error present. Phaselock techniques are most often used because the effective filter from input VCO output can be made to have a very narrow bandwidth. As a result, effects of the noise accompanying the input signal can be rejected to a considerable extent. Some methods for testing phaselock receivers and other phaselock equipment are included. R.W.H.

N66-10528# Queens Univ., Kingston (Ontario). Dept. of Electrical Engineering.
ANALYSIS OF A SIMPLIFIED SAMPLED SIGNAL DETECTOR
V. C. Hamacher Mar. 1965 112 p refs
(Contract DRB-413000)
(RR-65-1) CFSTI: HC $4.00/MF $0.75

A proposed simplified detector of sine waves in background noise is analized and compared to the known optimum detector when the noise is gaussian. The signal and noise mixtures are assumed to be known at a finite number of equally spaced time intervals, and the signal time of arrival is also known. The detector performs only additions on the sampled mixture of signal and noise under the assumption that the noise is band-limited and white, and has the autocorrelation of $R(\tau) = \exp(-a|\tau|)$. A digital computer simulation of a sampled gaussian process with specified autocorrelation shows that the sampled output of a continuous filter can be formed as a linear function of the past and present sampled input, and past sampled output. The simplified detector attains a minimum total probability error of about 17%, as compared to the optimum detector's 15%, when operating on random phase. G.G.

N66-10532# New York Univ., N. Y. School of Engineering and Science.
AN ANALYSIS OF TELETYPE TEST EQUIPMENT
Herbert Shanker Oct. 1964 82 p
(Contract NObsr-89288; Proj. SETE)
(SETE-210/80; AD-469148)

The purpose of this report is to discuss the malfunctions most commonly encountered in teletype circuits, together with the special purpose test equipment used for measurement of the pertinent parameters of an operating teletype network. The

need for special measurement instruments is principally confined to the detection monitoring and measurement of a class of malfunctions commonly known as 'distortion'. These malfunctions most often are manifested by incorrect reception of messages, or total inability to communicate over a teletype link, although apparent mechanical functioning of the physical equipment is maintained. Consequently, the test techniques and equipment required are peculiar to teletype systems.
Author (TAB)

N66-10535# General Electric Co., Syracuse, N. Y. Radio Guidance Operation.
LUNAR FARSIDE DATA LINK
G. L. Dunn, G. C. Minor, M. E. Myton, C. A. Dashby, and D. R. Rice 14 Apr. 1963 64 p refs
(Rept.-63-SPC-5)

A null-point communications satellite concept is presented for communications between wide spaced terminals on the far side of the moon, and between any point on the far-side lunar surface and an earth based terminal. The dynamic behavior of a satellite in the vicinity of the libration point is investigated analytically by the restricted four-body problem, and the required station keeping thrust is determined. Attitude control requirements are developed and a system implementation for a wide-band communications system is presented. Examinations of optical techniques, the power supply, and the overall vehicle considerations are included. G.G.

N66-10542# Mitre Corp., Bedford, Mass.
ATTENUATION OF THE GROUND WAVE OF A LOW FREQUENCY ELECTROMAGNETIC PULSE
J. C. Morgenstern and J. R. Johler (NBS) Apr. 1965 36 p refs Prepared jointly with National Bureau of Standards
(NBS-TN-310) GPO: $0.30

The attenuation of the peak of the ground wave EM pulse is presented as a function of distance. These attenuation functions are compared to combinations of single frequency attenuation functions and simple attenuation functions based on inverse distance raised to integral and non-integral exponents, $(1/d)^n$. Author

N66-10618*# Auburn Univ., Alabama. Auburn Research Foundation.
RADIO FREQUENCY SYSTEMS. MILLIMETER WAVES STUDY Fourth Quarterly Report, 1 Dec. 1964–1 Mar. 1965
M. A. Honnelli and E. R. Graf [1965] 31 p
(Contract NAS8-11184)
(NASA-CR-67879) CFSTI: HC $2.00/MF $0.50 CSCL 09F

A new amplifier for use in triggering the oscilloscope in the ground station of the radar altimeter instrumentation system was built and tested. A manual describing the operation and calibration procedure for the entire system was prepared. Design work began on a solid-state 2280 megacycle television exciter. Progress is included on the design work of this exciter unit and on the millimeter wave study. R.N.A.

N66-10620# Weapons Research Establishment (Australia).
AN UNATTENDED S-BAND RADIO INTERFERENCE MONITOR
W. Mettyear Oct. 1965 31 p refs
(WRE-TN-APD-2) CFSTI: HC $2.00/MF $0.50

A proposal for continuously monitoring the S-band frequencies allocated for deep-space communications is described with special reference to the Deep Space Instrumentation Facility at Tidbinbilla, (DSIF 42) and the Apollo Station at Honeysuckle Creek, Australian Capital Territory. Author

N66-10654# Joint Publications Research Service, Washington, D. C.
ON THE APPLICATION OF FM INFORMATION TRANSMISSION IN HYDROLOGICAL INSTRUMENT-BUILDING
V. G. Volkov and B. V. Shekhv 29 Oct. 1965 21 p refs Transl. into ENGLISH from Vopr. Metodiki Okeanologicheskikh Issled., Tr. Insa Okeanol., Akad Nauk SSSR (Moscow), v. 39, 1960 p 10–24
(JPRS-32635; TT-65-33114) CFSTI: $1.00

This report presents a basic trend in hydrological instrument electronics and calls attention to the potential of frequency modulation for solving problems of remote control measurements *in situ*. Several hydrological instruments, using frequency modulation for information transmission, are described which measure temperature, salinity, current velocity, and depth. R.N.A.

N66-10691*# Research Triangle Inst., Durham, N. C.
A STUDY OF THE EFFECTS OF INTERFERENCE ON NARROW-BAND PHASE LOCK LOOPS Final Report
P. G. Smith et al 15 Oct. 1965 94 p refs
(Contract NAS1-5065)
(NASA-CR-66036) CFSTI: HC $3.00/MF $0.75 CSCL 17B

An experimental investigation of the effects of interference on narrow-band phase lock loops was conducted to determine the degree of performance degradation caused by interfering signals on the ground-station receivers of space-research communication systems. Experiments were performed with narrow-band phase lock circuits which had the same transfer characteristics as those currently used in space research receivers. These circuits were subjected to two types of interfering signals: (1) varying levels of cw interfering signals which were swept through the loop bandpass at varying rates; and (2) varying levels of a noise modulated FM interfering signal of low modulation index which simulated the power spectral density of a FM radio relay trunk with 1800 loaded voice channels. Experiments are described and analysis of data discussed. A comparison is made between the experimental results and a theoretical analysis. Author

N66-10754# Michigan Univ., Ann Arbor. Cooley Electronics Lab.
COMPUTER TECHNIQUES FOR THE EVALUATION OF DETECTOR PERFORMANCE Technical Report No. 160
Joseph N. Gittelman May 1965 84 p refs *Its* Rept.-03674-7-T
(Contract Nonr-1224(36))
(TR-160; AD-469185)

In many situations, the theory of signal detectability lacks a connection between the theoretical aspects and the practical implementation of a detector. This condition exists because there are no general techniques for evaluating the detector performance. This report contains a collection of available techniques which have been adapted for the computer evaluation of a large class of detectors. In addition to the classical approximations, the Pearson system of frequency curves is integrated into the computer programs. The Pearson system yields a closed-form approximation to the detector performance, based on the moments of the signal and noise distribution functions. Such closed-formed approximations enable the user to evaluate the effects of signal-to-noise ratio, detector nonlinearities and filter bandwidth. Author (TAB)

N66-10765# Naval Research Lab., Washington, D. C.
THE DUAL CALSPHERE EXPERIMENT
R. R. Zirm, R. E. Brescia, and R. S. Rovinski 30 Jul. 1965 12 p refs
(NRL-6271; AD-620353)

Two smooth polished 14-in.-diameter aluminum spheres weighing 2.2 lb and 22 lb have been simultaneously injected into nearly identical 600-naut-mi circular polar orbits. These spheres will provide (a) standard radar targets and (b) observations of the relative change in the orbital parameters with time. Since the scattering cross section of these spheres is less than 0.1 sq ft at 108 Mc, they are not adequate for Space Surveillance System calibration at the present time, although they will be seen more often when system frequency is increased to 216 Mc and transmitter power is increased. They are seen often enough at present, however, so that good orbital elements are obtained from the U.S. Navy Space Surveillance System observations, and it has been possible to identify the light satellite and the heavy one from the relative change in semimajor axis caused by residual atmospheric drag. A density measurement has been obtained from the decrement of the semi-major axis of the light sphere that agrees to within ten percent with the accepted value for the quiet-sun period.
Author (TAB)

N66-10808# Oklahoma Univ., Norman.
THE DESIGN AND ANALYSIS OF AN ACTIVE, TUNABLE BANDPASS FILTER
Mike W. Gural (M.S. Thesis) 1965 76 p refs
(Contract AF 33(608)-1096)
(AD-620441)

The purpose of this paper is the analysis and design of a bandpass filter with an attenuation of at least 30db per octave in the rejection band and a bandwidth of one-third octave. This filter is to be tunable over the range of frequencies from 5 cps to 20 kcs.
TAB

N66-10827# New York Univ., N. Y. Lab. for Electroscience Research.
WORD-SELECTION PROCEDURES FOR ERROR-FREE COMMUNICATION SYSTEMS Second Scientific Report
John J. Metzner and Kenneth C. Morgan Jun. 1965 82 p refs
Its Tech. Rept. No. 400-113
(Contract AF 19(628)-4321)
(AFCRL-65-461; AD-621323)

This report describes three alternative sets of rules, or procedures, capable of regulating the flow of message words in a feedback communication system—the circulating memory procedure, the interlace procedure, and the 'go back' procedure. The first two of these have been mentioned briefly in previous reports and the third has been described elsewhere. The procedures are evaluated and compared with respect to complexity and storage requirements, operational logic, and compatibility with cumulative decision techniques. A preliminary study of their effect on transmission time and hence on system efficiency is also presented.
Author (TAB)

N66-10838# National Severe Storms Lab., Norman, Okla.
PAPERS ON WEATHER RADAR, ATMOSPHERIC TURBULENCE, SFERICS AND DATA PROCESSING Technical Note No. 3
Charles G. Clark, William E. Cobb, J. T. Dooley, Kathryn C. Gray, William C. Herrmann et al Washington, Dept. of Commerce, Aug. 1965 144 p refs
(NSSL-24; AD-621586)

Contents: Wsr-57 reflectivity measurements and hail observations; Thunderstorm turbulence and radar echoes; 1964 data studies; Circularly polarizable radar and hail detection; Wave length dependence of the radar reflectivity of water and ice spheres; Sferics reception at 500 KC./SEC., radar echoes, and severe weather; Locating and tracking areas of lightning; NSSL radarhydrology program; Computer program for calculating average lengths of weather radar echoes and pattern bandedness; Data processing at NSSL in 1964; Radar data acquisition techniques; and NSSL mesoscale network of surface stations.
TAB

N66-10842# Philco Corp., Blue Bell, Pa. Advanced Technology Center.
ADVANCED ANTENNA TECHNIQUES Scientific Report No. 1, Nov. 1964–Jun. 1965
Leo W. Procopio, Thomas K. Kashihara, and Stephen Czorpita Jul. 1965 94 p refs
(Contract AF 19(628)-4769)
(AFCRL-65-551; AD-621555)

The results of preliminary investigations into antenna techniques which employ the angular dispersion–compression principle are presented. The report includes a description of various processing schemes, including detailed discussion of the cylindrical disc array, and a study of the general synthesis problem for ambiguity functions. In the latter study, the use of pseudo-random illumination functions is analyzed as a means for achieving dispersed patterns and good pattern correlation properties. The report also presents additional studies in superdirectivity and angular resolution. The problem of synthesizing a superdirective illumination function for a plane, circular aperture is presented and is shown to be closely approximated by the field distribution of a circular confocal cavity. The resolution constants associated with angle rate, and combined angle-angle rate are derived; resolution in angle-rate is found to be a constant, indicating a fundamental tradeoff between resolution in angle and that in angle rate. Finally, the six dimensional resolution constant, containing the parameters range, azimuth, elevation, and their respective rates of change, is discussed. It is shown that for a particular set of assumptions regarding antenna processing, the six dimensional resolution hyperspace is a constant.
Author (TAB)

N66-10850# Army Missile Command, Huntsville, Ala. Instrumentation Branch.
AN EVALUATION OF THE LANCE PULSE CODE MODULATION SYSTEM
William C. Kelly Aug. 1965 20 p
(RG-TE-65-18; AD-471023)

This report contains an evaluation and a functional description of the pulse code modulation system used on the LANCE missile. A section is included which analyzes the ability of the system to produce a signal which can be satisfactorily synchronized and decommuted in a telemetry ground station. Another section presents the results of accuracy and linearity tests. The accuracy data is compared with the theoretical resolution limit. The frequency response of the system is discussed in a section which describes the relation between the response and the data sampling rate.
Author (TAB)

N66-10859# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A NOISE REJECTION FILTER FOR WAVEGUIDE CARRYING HIGH POWER
W. J. Getsinger 3 Aug. 1965 22 p refs
(Contract AF 19(628)-5167)
(TN-1965-30; ESD-TDR-65-315; AD-619580)

A novel design for a waveguide band-rejection filter carrying high power in its pass band is presented. The resonant cavities of the filter are mounted in pairs on the narrow walls

of the guide and coupled to the guide through rectangular openings the full height of the guide. Thus there are no edges or radii on which electric field concentrations can occur. An X-band model having six cavity pairs had a rejection greater than 80 db over 45 Mcps in its stop band with an insertion loss under 0.05 db and VSWR under 1.02 in its pass band. With water cooling, the filter carried over 300 kw CW without breakdown. Author (TAB)

N66-10882*# Ohio State Univ. Research Foundation, Columbus. Dept. of Electrical Engineering.
AN INTERFEROMETRIC RECEIVER FOR SUBMILLIMETER RADIOMETRY
R. A. Williams 1 Feb. 1965 163 p refs *Its* Rept.-1093-25
(Grant NsG-74-60)
(NASA-CR-67704) CFSTI: HC $5.00/MF $1.00 CSCL 09F

Radiometry in the submillimeter wavelength region differs from centimeter-wavelength radiometry in three basic aspects: (1) for low-temperature sources the Rayleigh–Jean approximation to Planck's radiation law no longer applies and the complete Planck expression must be used, (2) due to the large size of the radiation detector the radiometer beamwidth is determined by geometrical optical effects rather than by diffraction effects due to the size of the antenna aperture, and (3) since the superheterodyne principle used at lower frequencies has not yet been developed for use in the submillimeter-wavelength region the selection of the wavelength region which it is desired to measure must be accomplished by quasi-optical means. The first two aspects of the submillimeter radiometry problem are discussed and summarized in graphical and tabular form. The third aspect of the problem in the major subject matter of the dissertation. Author

N66-10894# Kokusai Denshin Denwa Co., Ltd., Tokyo (Japan). Research Lab.
PROJECT RELAY I REPORT ON COMMUNICATION EXPERIMENTS CONDUCTED AT KDD EARTH STATION, IBARAKI, JAPAN
Apr. 1964 22 p
(RR-1) CFSTI: HC $1.00/MF $0.50

Wideband communication tests and demonstrations performed with the Relay I satellite at the Kokusai Denshin Denwa space communications station in Japan are summarized; positions of the Relay I during the experiments is tabulated. Experimental results are given for insertion and gain stability, noise measurement, nonlinear and linear distortion, received signal power, and television tests. On the basis of short-term testing, it is concluded that the transmission characteristics of the satellite-borne Relay instruments and the ground-based receiver are quite good. Quality of TV video was fairly good, although audiosignals were not good and the effect of spin fading was marked. M.W.R.

N66-10895# Kokusai Denshin Denwa Co., Ltd., Tokyo (Japan). Research Lab.
PROJECT RELAY II REPORT ON WIDEBAND COMMUNICATION EXPERIMENTS CONDUCTED AT KDD EARTH STATION, IBARAKI, JAPAN
Aug. 1964 17 p
(RR-6) CFSTI: HC $1.00/MF $0.50

Results of wideband communication tests and experiments utilizing the Relay II satellite are tabulated. Areas considered include: technical tests with television signals; system noise temperature measurements; a demonstration program; measurement of antenna pattern; and a power reduction experiment. A comparison between calculated and observed orbital data is included. C.T.C.

N66-10896# Kokusai Denshin Denwa Co., Ltd., Tokyo (Japan). Research Lab.
PROJECT RELAY II REPORT ON NARROWBAND COMMUNICATION EXPERIMENTS CONDUCTED AT KDD EARTH STATION, IBARAKI, JAPAN
Oct. 1964 20 p refs
(RR-9) CFSTI: HC $1.00/MF $0.50

Directivities of communication antenna provided with a 6/4 Gc horn were measured by receiving a communication signal on 4170 Mc from the satellite and by setting the axis of antenna gradually off the true direction to the satellite according to orbiting of it only in azimuth or elevation. Examples of directive patterns in planes of azimuth and elevation as observed on Rev. 1038 were shown. It was concluded that: (1) telephone circuit via Relay II had good quality in high signal to noise ratio and low distortion, and was suitable for the international connection; (2) the facility at COMIBA had a margin for 12-channel two way telephoning via Relay II satellite; (3) multiple loop test indicated that a good operation of the echo suppressor was for the telephone circuit via a high altitude satellite; and (4) in order to analyze the interference from the domestic microwave system to the satellite, many tests will be needed. R.W.H.

N66-10897# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
MICROWAVE OPTICAL RECEIVER TECHNIQUES Interim Engineering Report, 1 Jun.–31 Aug. 1965
J. Richard Kerr [1965] 49 p refs
(Contract AF 33(615)-3108)
(IER-1; AD-620825)

This report presents the results of the first quarter of effort on a one-year applied research program on the use of various techniques for microwave optical communications through the atmosphere. Theoretical considerations of the relative advantages of direct and heterodyne optical receivers, taking into account the vastly increased sensitivity of new phototubes under development in this laboratory, show that heterodyne detection may in many cases be less advantageous than popularly assumed. A qualitative examination of the different possibilities for optical and subcarrier modulation in wideband systems illuminates the system requirements. The use of multimode lasers in such systems is also studied. Experiments have centered on the laboratory optimization of the advanced multiplier phototubes, in order to obtain a consistent, rugged unit for use in the outdoor experiments. A system has been constructed which eliminates the problem of microwave leakage pickup, while avoiding the necessity for screening or shielding techniques. Author (TAB)

N66-10898# ADCOM, Inc., Cambridge, Mass.
STUDY OF RANDOM SCAN TV TRANSMISSION Final Report, 30 Jun. 1964–31 May 1965
Philip A. Bello, Charles J. Boardman, Cesar A. Filippi, and Steven M. Sussman 15 Jul. 1965 141 p refs
(Contract AF 19(628)-4308)
(AFCRL-65-535)

The report is concerned with the study of the modulation-demodulation and synchronization problems arising in random-scan TV signals, which are characterized by the pseudo-random selection of the spacial positions of the TV elements. The transmission channels considered were troposcatter and line-of-sight propagation in the S- and X-Band. Both analog and digital modems were studied. Also, the modulation and synchronization problems of a simulated random scan based on a repetitive linear sweep followed by a point selector are discussed. Author (TAB)

N66-10951 European Organization for Nuclear Research, Geneva (Switzerland).
A DISTRIBUTED CARRIER MULTIPLEX SYSTEM FOR FLEXIBLE REMOTE CONTROL AND TELEMETRY: APPLICATIONS
B. Sagnell 1 Sep. 1965 37 p refs
(CERN-65-28)

Some practical applications of the CERN multiplex system are reported, and the characteristics of the system parts are summarized. The experiences with the present carrier multiplex system have shown it to be a practical, reliable, and economical method for remote control and telemetry. New multiplex equipment is presently being designed which will be smaller, lighter, faster and more reliable than the current system, and more convenient. R.W.H.

N66-10957*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
THEORETICAL CURVES OF BACKSCATTERING CROSS SECTIONS OF ROUGH SURFACES FOR SEVERAL POLARIZATION STATES USING TWO STATISTICAL MODELS
Donald E. Barrick 31 Aug. 1965 51 p *Its* Rept.-1388-20
(Grant NsG-213-61)
(NASA-CR-67933) CFSTI: HC $3.00/MF $0.50 CSCL 20N

Predicted curves of backscattering cross section per unit area (in decibels) of very rough planar surfaces are shown in this report. Two statistical models for the surface joint probability density function are considered and the curves from each are shown. Results are shown for both perfectly conducting and lossy dielectric surfaces at several values of dielectric constant. The only roughness parameter which affects the shape of the cross section curves for the models considered here is the rms surface slope. The various cross sections (including the cross or depolarized cross sections) are shown here for both linear and circular polarization states. The purpose of the report is to provide a set of curves with which one may compare measured curves in an attempt to estimate the parameters and properties of the surface from which the backscattered power was measured. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N66-10423*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STUDY OF THE ACCURACY OF THE DOUBLE-PRECISION ARITHMETIC OPERATIONS ON THE IBM 7094 COMPUTER
C. L. Lawson 15 Jul. 1963 18 p
(Contract NAS7-100)
(NASA-CR-67759; JPL-TM-33-142) CFSTI: HC $1.00/MF $0.50 CSCL 09B

The IBM 7094 operations DFMP, DFDP, DFAD, and DFSB and the FORTRAN II library subroutines (DFMP), (DFDP), (DFAD), and (DFSB) were tested by applying each to 32,000 pairs of random arguments uniformly distributed between 0.5 and 1.0. The operations DFAD and DFSB performed true 54-bit floating-point arithmetic. The operation DFMP gave a correctly rounded 54-bit result in only 3.6% of the cases, and the error ranged from −6.00 to 0.00 in units of the last bit position of the product. The relative error ranged from $-0.750 * 2^{-50}$ ($= -0.666 * 10^{-15}$) to 0. The corresponding figures for DFDP were 47.2%, −3.48 to 2.72, and $-0.45 * 2^{-51}$ ($= -0.20 * 10^{-15}$) to $0.62 * 2^{-51}$ ($= 0.28 * 10^{-15}$). The subroutines were less accurate on the average than the corresponding hardware operations; however, there were cases such as multiplication by 1.0 (or by any other exact power of 2) in which the reverse was true. Author

N66-10446# System Development Corp., Santa Monica, Calif.
AUTOMATED SYSTEM IMPLEMENTATION Preliminary Study Report
Michael R. Lackner and Patricia Kribs 10 Feb. 1964 11 p
(TM-1742(000)00; AD-431054)

Reports that the Automated System Implementation (ASI) Project which was designed to identify and initiate research activities necessary for the development of automated system implementation technology has completed a six-month period of study and exploration. States that the object of this research is to specify and develop techniques which can become coherent components of a highly automated scheme for implementing information processing systems, will be independently useful in developing information processing systems, and can be established as feasible within a two-year period. TAB

N66-10511# Institutt for Atomenergi, Halden (Norway). OECD Halden Reactor Project.
DEVELOPMENT AND APPLICATIONS OF DATA HANDLING AND PROCESSING AT HBWR
G. Ksaerheim, O. Vapaavuori, and J. Hannaford Nov. 1964 56 p refs
(HPR-47) CFSTI: HC $3.00/MF $0.50

A comprehensive source of information on the development and applications of the data handling and processing facilities is presented. Various components are shown of the present data reduction system indicating the possibilities for flow and analysis of experimental data. The signals from instruments can be fed from the reactor, the assembly test loop, the cold calibration loop or the electrically heated boiling test loop to either the experimental control room or to the calibration room. The arrangement of the test rack in the experimental control room permits all signals to be supplied to any instrument through a three pin socket-jumper cable arrangement. R.W.H.

N66-10531# New York Univ., N. Y. School of Engineering and Science.
COMMERCIAL ANALOG TO DIGITAL CONVERTERS AND RELATED INSTRUMENTS
Henry S. Lax Oct. 1964 69 p
(Contract NObsr-89288; Proj. SETE)
(SETE-210/81; AD-469151)

Functions of analog to digital converters are summarized, and the conversion methods used are briefly described. Commercially available converters are tabulated according to (1) analog to digital converters with voltage input, and digital to analog converters; (2) analog to digital converters with shaft input; and (3) voltage to frequency converters, and frequency to voltage/current converters. A list of testers is also included. M.G.J.

N66-10539# United Kingdom Atomic Energy Authority, Harwell (England). Electronics Div.
THE MOST ACTIVE ZONE ENCODER FOR MULTIPARAMETER ANALYSIS
G. C. Best, S. A. Hickman, I. N. Hooton, and G. M. Prior London, HMSO, Jun. 1965 24 p refs
(AERE-R-4949) HMSO: 3s

The advantages of associative analysis for multiparameter and similar complex data are discussed. The difficulties are indicated, and an account given of how these are overcome in the design of the Most Active Zone Encoder, which forms the basis of a fully associative analyser. Author

N66-10561*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PROCEEDINGS OF NASA/INDUSTRY PERT COMPUTER CONFERENCE
[1964] 171 p Conf. held in Houston, 22–24 Jul. 1964
(NASA-TM-X-56870) CFSTI: HC $5.00/MF $1.00 CSCL 09B

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3. NASA PERT "C" SYSTEMS LOGIC AND REPORT GENERATION Larry Stevens and John Leonard 51 p
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12. QUESTION AND ANSWER SESSION 10 p

N66-10595# Praxis Calcolo, S.p.A., Milan (Italy).
APACHE: ANALOG PROGRAMMING AND CHECKING PROGRAMMERS MANUAL
Brussels, EURATOM, Jun. 1965 195 p
(Contracts EURATOM-026-62-2 CETI; EURATOM-036-63-3CETI; EURATOM-035-64-3 CETI)
(EUR-2437.e) CFSTI: HC $5.00/MF $1.25

This manual has been written to help the analog programmer in writing APACHE programs. It describes in detail the language and its limitations, and gives the procedure for the utilisation of the code on the digital computer (IBM 7090). The language illustrated is APACHE, Version IV. Author

N66-10688*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NIMBUS HRIR EQUIPMENT DIAGNOSTIC TEST PROGRAM
Howard R. Stagner Aug. 1965 32 p ref
(NASA-TM-X-55293; X-564-65-328) CFSTI: HC $2.00/MF $0.50 CSCL 09B

A diagnostic test program, developed for checking and maintaining the high resolution infrared (HRIR) equipment in the Nimbus digitizing system, is described. It permits equipment function select and sense codes to be tested, and any selection of HRIR equipment modules and settings to be established for subsequent checks of data and time inputs. Either FM data, or simultaneous FM and time data can be input a a block at a time or continuously in a loop mode; data storage on digital tape is optional. A data analysis routine computes and prints the number of FM data words (24 bit) read in during vehicle time frames, and of FM data samples between FM data sync patterns; and lists first and second differences for data samples derived from the linear calibration portion of the data simulator input. A routine is also included to print out the raw FM and time data as it was originally read into the computer. Operating procedures and run modes are described, and program listings are included. The program has a modular design for easy addition of test functions and routines. M.G.J.

N66-10768# Naval Ammunition Depot, Crane, Ind. Research and Development Dept.
COMPUTER PROGRAM FOR THE ANALYSIS OF VISIBLE SPECTROMETRIC DATA: CHROMATICITY
James A. Swinson 26 Aug. 1965 44 p refs
(RDTR-59; AD-620295)

The report includes a detailed description of a computer program used with an IBM 1620 computer to reduce and analyze spectrometric data from the visible spectrum. Included is a point by point outline of the operations performed by the program and discussion of its uses, which are to calibrate the spectrometer from collected data and to determine and print out the system response of the spectrometer and relative energy distribution vs wavelength, relative luminous intensity (candlepower) and the x, y, and z chromaticity coordinates for an unknown. The necessary information for computer input and a suggested format for recording this data is outlined, along with instructions for key-punching the input data cards and instructions for the computer operator. The FORTRAN statements for the program are included. Author (TAB)

N66-10857# RAND Corp., Santa Monica, Calif.
COMPUTER PROGRAM FOR OPTIMUM LOW-THRUST ORBIT TRANSFERS
J. A. Jolissaint Sep. 1965 120 p refs
(Contract AF 49(638)-700)
(RM-4704-PR; AD-620876)

The memorandum describes a digital computer program written in FORTRAN IV, which simulates mathematically a multi-stage low-thrust orbit transfer process. The process provides a means of transferring a space vehicle from some initial orbit to a desired terminal orbit along an optimum path with respect to some quadratic performance criteria. The program was generalized to enable it to handle such problems as orbit correction of a 24-hour communication satellite, transfer of a vehicle from an orbit around earth to one around a neighboring planet, or rendezvous of a space vehicle with an earth satellite. The memorandum may serve as a reference manual for those desiring to use the program, and it was organized so that the user can acquaint himself with the program to any degree desired. After a general description of the program, its capabilities and limitations, and a complete set of instructions concerning its use, two numerical examples are given. This material should provide sufficient detail for anyone desiring to use the program in its present form. For those wishing to modify or examine the substance of the program, a complete description of each routine including equations and flow charts is given. Author (TAB)

N66-10911# RAND Corp., Santa Monica, Calif.
STOCHASTIC SENSITIVITY ANALYSIS OF MAXIMUM FLOW NETWORKS

Richard D. Wollmer Aug. 1965 34 p refs
(Contract Nonr-222(83); Grant NSF GP-2633)
(P-3195; AD-619991)

A maximum flow network is defined by a set of arcs and a set of points called nodes. Each arc joins two nodes and has associated with it a positive capacity which represents the maximum amount of flow that may pass over it. One of the nodes is designated as the source and another as the sink. From these nodes, arcs, and capacities the maximum amount of flow that may pass from source to sink may be calculated. This investigation is concerned with a sensitivity analysis on a class of such networks known as planar networks. Specifically, each arc of the network is subject to anywhere from one to n breakdowns which result in a reduction in its capacity. The amount of this reduction in capacity is a random variable with known mean and variance. It is desired to find the smallest possible value of F resulting from, at most, n breakdowns. TAB

N66-10921# Westinghouse Electric Corp., Baltimore, Md. Defense and Space Center.
NUMERICAL TECHNIQUES FOR ADVANCED COMPUTERS Final Report, Feb. 1964–Mar. 1965
George Shapiro, J. S. Squire, M. L. Graham, F. M. Carroll, D. Cawood et al Griffiss AFB, N. Y., RADC, Aug. 1965 139 p refs
(Contract AF 30(602)-3313)
(RADC-TR-65-138; AD-469697)

The purpose of the research performed under this contract was to investigate numerical techniques for advanced computers. Existing numerical techniques were studied to determine if they could be efficiently implemented using new types of logic organization. Non-standard numerical techniques were developed that yielded improvements by taking advantage of new computer organizations. Author

N66-10928*# Maryland Univ., College Park. Computer Science Center.
TREETRAN—A FORTRAN IV SUBROUTINE PACKAGE FOR MANIPULATION OF ROOTED TREES
John L. Pfaltz Sep. 1965 70 p refs
(Grant NsG-398)
(NASA-CR-67920; TR-65-23) CFSTI: HC $3.00/MF $0.75 CSCL 09B

A manual of rooted tree routines is presented to permit researchers in diverse fields to manipulate tree structures in Fortran. It is pointed out that rooted trees may be considered as a formalization of the situation where the nature of an event is dependent upon a single preceding event in space or time; a graph is included. Fortran IV implementation is discussed; and the use of the Treetran subroutines, and tree construction and output are described. Manipulative routines are given for an arbitrary tree structure; tree equality and isomorphism are considered; and a way to graphically represent a data tree is shown. An example of a problem using tree structured data is included. Treetran subroutines and functions are summarized; source listings are given; and a technical description of Treetran as a Slip list structure is included. M.G.J.

N66-10929*# Arizona Univ., Tucson. Engineering Experiment Station.
HYBRID COMPUTER MONTE-CARLO TECHNIQUES
Granino A. Korn, Brian K. Conant, Robert H. Whigham, and Baker Adams Mitchell, Jr. (Electron. Associates, Inc., Princeton, N.J.) [1965] 40 p refs *Its* EES Rept. No. 9
(Grant NsG-646)
(NASA-CR-67918) CFSTI: HC $2.00/MF $0.50 CSCL 09B

Hybrid analog–digital computer systems suitable for high-speed Monte-Carlo studies are introduced, and methods for reducing the computing time are suggested. Applications to the solution of partial differential equations and to random search optimization are outlined. Also described is the use of a fast iterative analog computer to study a sophisticated communications system, which uses amplitude modulated orthogonal polynomial waveforms as carrier signals. The design and performance of a fast wideband quarter-square diode multiplier for use with the ±10 v low impedance computing circuits of a high speed iterative differential analyzer, or other hybrid analog–digital computer systems, are also detailed. For work with a fast solid state iterative differential analyzer, an automatic multiparameter optimizer, employing sequential random parameter perturbation, was developed. Circuit schematics are included for all systems. M.G.J.

N66-10961# California Univ., Livermore. Lawrence Radiation Lab.
A MULTIPURPOSE THEOREM PROVING HEURISTIC PROGRAM THAT LEARNS
James R. Slagle Jan. 1965 6 p Revised
(Contract W-7405-ENG-48)
(UCRL-12342-T, Rev.)

A heuristic program is discussed which introduces several unique features into computer programing in general, and into automatic theorem proving, in particular. The program searches for a constructive proof or disproof of a given proposition, and the search procedure efficiently selects the seemingly best proposition to work on next. The program is multipurpose in that the domains it can handle are varied. It improves its search procedure with experience and thus learns to handle more difficult problems. C.T.C.

N66-10968# Atomics International, Canoga Park, Calif.
ANALOG COMPUTER FOR THE ARGON FLUX MONITOR
K. H. Kline 1 Jul. 1965 22 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11355) CFSTI: $1.00

An analog computer was designed and constructed for the purpose of solving any one of several equations to determine neutron flux by the activation of argon gas flowing through a piping system in a nuclear reactor. Inputs to the computer are from transducers measuring counting rate, pressure, mass flow, and temperature. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N66-10119 Joint Publications Research Service, Washington, D. C.
USE OF A ONE-PORT CONTAINING A TUNNEL DIODE AND A TRANSISTOR IN COMPUTER ELEMENTS
N. I. Ashebel', I. S. Yemel'yanova, and L. V. Postnikov *In its* News of Higher Educational Inst. 28 Feb. 1964 p 345–355 refs (See N66-10101 01-23) CFSTI: $6.00

For a one-port containing a tunnel diode and a transistor, the conditions for unique dependence of the current on the voltage are obtained, analogous to the static characteristic of

a thyratron. It is shown that it is possible to synthesize computer elements in which the reliability and the presence of a parallel output, which are inherent in thyratron circuits, combine with high operating speed. An experimental check is made of the operation of a ring counter using such a one-port. Author

N66-10120 Joint Publications Research Service, Washington, D. C.

ON THE DESIGN OF A TRANSISTORIZED VOLTAGE STABILIZER

L. V. Postnikov and V. Ye. Lyapukhov *In its* News of Higher Educational Inst. 28 Feb. 1964 p 356–367 refs (See N66-10101 01-23) CFSTI: $6.00

A simplified circuit is considered for a compensation-type transistorized voltage stabilizer. A region corresponding to normal operation is separated in the supply voltage plane. Within this region, the dependence of the output voltage on the supply voltage and on the circuit parameters is obtained. A stability investigation is carried out in the absence of correcting elements. Author

N66-10124 Joint Publications Research Service, Washington, D. C.

MEASUREMENTS OF AMPLITUDE FLUCTUATIONS OF A TRANSISTOR OSCILLATOR

Ye. A. Zdornova and A. N. Malakhov *In its* News of Higher Educational Inst. 28 Feb. 1964 p 381–386 refs (See N66-10101 01-23) CFSTI: $6.00

The amplitude fluctuations of a transistorized oscillator were measured with the aid of a low-frequency spectrum analyzer in the range from 1 to 100 cps. The measurements were made by a demodulation method using a cathode follower, a detector, and an analyzer. The oscillator signal passed through the cathode follower and was fed to a linear detector. The detector circuit was equipped with a voltage component proportional to the relative amplitude fluctuations. The spectral density of this component was measured with the aid of the spectrum analyzer. The detector circuit was equipped with a low-pass filter in order that only the signal with the oscillator frequency would reach the input of the detector without the low-frequency noise of the oscillator and repeater. The spectral density of the relative fluctuations of the amplitude averaged 80 sec. Relative amplitude fluctuations were then measured for the various types of transistors. The noise factors of some transistors were found to depend on the emitter current and others on the collector voltage. Also, a dependence on base voltage was also observed. Equations were then derived for the oscillator using the various type transistors. E.E.B.

N66-10155 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SUPPRESSION OF NOISE WHEN OBSERVING A NUCLEAR MAGNETIC RESONANCE SIGNAL OF A MAGNETIC FIELD MEASURER

G. S. Anufriev, O. F. Afonin, and B. A. Mamyrin *In its* Instr. and Exptl. Tech. 30 Jun. 1965 p 1–5 refs (See N66-10154 01-23)

Described are parameters of a system for stroboscopic transformation of a signal of nuclear magnetic resonance of an IMI-2 magnetic field measuring device. The system improves the signal/noise ratio by 5 to 50 times. Author

N66-10180 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TRANSMITTER OF A FREQUENCY TELEMETERING SYSTEM FOR SMALL VOLTAGE OUTPUT SIGNALS

O. N. Shcherban', R. A. Kaplan, and A. V. Primak *In its* Automation 2 Apr. 1965 p 40–44 refs (See N66-10176 01-10)

An instrument for telemetering low voltage signals from pickups with ac and dc outputs has been developed, based on the principle that the controlled generator acts as the supply source of a magnetic differential amplifier which, by amplifying the pickup signal, controls the frequency of the generator. Design and construction details are given, and diagrams of the transmitter and the basic circuitry are included. Laboratory tests of an experimental model showed that the frequency remained constant over a period of continuous operation, independent of wide ambient temperature ranges and supply voltage variations. The frequency characteristics of the transducer as a function of supply voltage variations with and without feedback between the generator output and the magnetic amplifier are illustrated, and the frequency dependence on the pickup signal is also depicted. M.G.J.

N66-10184 Air Force Systems Command, Wright-Patterson AFB, Ohio.

A PULSE MAGNETRON GAS DISCHARGE COUNTER

G. B. Bohdanov and S. O. Senets'kiy *In its* Automation 2 Apr. 1965 p 81–84 refs (See N66-10176 01-10)

The phenomenon of magnetron arcing is discussed, and a pulse magnetron gas discharge counter, for automatic magnetron transmitter operation control, is described. The basic circuit diagram of the counter shows that one of the main components is a pulse electronic switch with a positive feedback, with the input at the secondary winding of the transformer. The primary winding is connected into the path of the dc component of the magnetron current, monitored by a milliammeter. During a gas discharge in the pulse magnetron, the current flowing through the primary winding sharply increases and produces voltage pulses in the secondary. These are applied to a single-stage transistor amplifier with a transistor triode. The excitation winding of a polarized relay is connected in the collector. When the relay is operated, it closes the circuit of an electromechanical pulse counter, which counts the gas discharges in the pulse magnetron. The mechanical design of the counter is included. M.G.J.

N66-10185 Air Force Systems Command, Wright-Patterson AFB, Ohio.

DIGITAL-TO-ANALOGUE ALTERNATING CURRENT OPERATED CONVERTER

L. I. Voronova and Yu. V. Krementulo *In its* Automation 2 Apr. 1965 p 85–88 (See N66-10176 01-10)

A simple digitial-to-analogue ac converter, based on a transformer circuit for voltage addition, is described. In the nonreversible converter, switches are controlled by the corresponding readouts of the register with the output voltage proportional to the number stored by the register. For a fast, reliable circuit, switches consist of semiconductor triodes, with the ac collector supply voltage used for the transistor switching arrangement. For a reversible converter, two switches are added in a coincidence circuit to the primary windings of the transformers. Technical data are given, and design and component information included. M.G.J.

N66-10222# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

H_{02} WAVE EXCITER IN A ROUND-SECTION WAVEGUIDE

M. V. Persikov 12 Aug. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 156975 (Appl. no. 776725/26-9, 3 May 1962) 2 p

(FTD-TT-65-632/1+2+4; AD-620762)

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An H_{02} wave exciter is proposed in a waveguide with a round section which has the distinguishing feature that for the purpose of lessening the losses in the conversion and increasing the working range of the frequencies in a waveguide of round section there are provided uniformly distributed projections around the circumference which have uniform height being part of sectors smoothly changing in dimensions of cross section of the waveguide from an angle of aperture equalling zero up to the angle of 360°. TAB

N66-10223# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DC VOLTAGE STABILIZER
Yu. N. Pryadilov 9 Aug. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 165782 (Appl. no. 824930/26-9, 23 Nov. 1964) p 28
(FTD-TT-65-962/1+2; AD-620760)

A dc voltage stabilizer with a load current of several amperes containing a magnetic amplifier and a bridge with a vacuum diode is described. In order to increase the accuracy of voltage stabilization during temperature variations in the surrounding medium a copper manganin thermodependent resistor is included in the diode heater circuit. The resistor is mounted with manganin wire. A thermostable resistor which compensates for temperature variations of the output voltage regulator potentiometer is included in the output bridge circuit.
Author (TAB)

N66-10338*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HYSTERESIS AND EDDY-CURRENT LOSSES OF A TRANSFORMER LAMINATION VIEWED AS AN APPLICATION OF THE POYNTING THEOREM
John Barranger Washington, NASA, Nov. 1965 20 p refs (NASA-TN-D-3114) CFSTI: HC $1.00/MF $0.50 CSCL 20C

An energy-loss equation is developed based on the Poynting theorem. The resultant integrals provide a unified viewpoint that is shown to be the same as the classical eddy current and hysteresis energy formulations. An expression is derived for the eddy current loss of a thin transformer lamination by assuming that the permeability is constant, and further, that the magnetic material is isotropic and homogeneous. The hysteresis loss is found by assuming that the introduction of the hysteresis loop does not alter the fields. The results indicate that, for a given total flux and at frequencies approaching total shielding, both losses are proportional to the 3/2 power of frequency and the square root of the conductivity and inversely proportional to the square root of permeability. Author

N66-10348# General Electric Co., Philadelphia, Pa. Missile and Space Div.
LIFE TESTS ON CAPACITORS FOR PULSED PLASMA ENGINE APPLICATIONS
Bernard Gorowitz and Thomas W. Karras Jun. 1965 13 p (R65SD26)

A description is given of tests conducted with some off the shelf energy storage capacitors for the purpose of investigating life, failure modes and weight to power ratios. Up to 6.4×10^7 shots were obtained with a given unit. Suggestions for the improvement of capacitor reliability and weight to power ratio are presented. Author

N66-10389* Hewlett-Packard Co., Palo Alto, Calif.
SOME ASPECTS OF THE THEORY AND MEASUREMENT OF FREQUENCY FLUCTUATIONS IN FREQUENCY STANDARDS
L. S. Cutler *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 12 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

Precision quartz oscillators have three main sources of noise contributing to frequency fluctuations: thermal noise in the oscillator, additive noise contributed by auxiliary circuitry such as AGC, etc., and fluctuations in the quartz frequency itself as well as in the reactive elements associated with the crystal leading to an f^{-1} type of power spectral density in frequency fluctuations. The influences of these sources of noise on frequency fluctuation versus averaging time measurements, using the multiple-period beat frequency measuring technique, will be discussed. The f^{-1} spectral density leads to results which depend on the length of time over which the measurements are made. The characteristics of atomic standards using a servo-controlled quartz oscillator will be discussed. The choice of servo time constant influences the frequency fluctuations observed as a function of averaging time, and should be chosen for best performance with a given quartz oscillator and environmental condition. Author

N66-10391* Varian Associates, Beverly, Mass.
A CROSS-CORRELATION TECHNIQUE FOR MEASURING THE SHORT-TERM PROPERTIES OF STABLE OSCILLATORS
R. F. C. Vessot, L. F. Mueller, and J. Vanier *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 8 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50
(Contract NAS8-260)

A cross-correlation technique for measuring the properties of stable oscillators in the time range 0.01 to 1.0 sec is described. Time-dependent functions representing signals from two separate oscillators are led to a function multiplier, where the instantaneous product of the functions is made. The oscillators are either set to a given phase relation or allowed a small relative drift so that a slow beat frequency is observed. Short-term fluctuations superimposed on the slow beat signal from the multiplier output represent the instantaneous phase difference between the oscillators when the inputs are in quadrature. When the inputs are in or out of phase, the fluctuations represent signal amplitude variations. Sampling times can be specified by filters having certain responses. The mean-square frequency deviation taken over a given response time is obtained by differentiating, filtering, and squaring the output signal of the function multiplier—data being taken when the input signals are in quadrature. Data from measurements on hydrogen masers are presented, and a comparison of these results with data taken using the zero crossing method over the range 0.1 to 10 sec is given. The effect of thermal noise is seen to be the major factor limiting the short-term frequency stability of the signals. Author

N66-10393* Army Elelctronics Labs., Fort Monmouth, N. J.
THE EFFECTS OF NOISE ON CRYSTAL OSCILLATORS
E. Hafner *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 23 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

A first-order perturbation analysis has been used to derive an explicit expression for the output signal of an oscillator with noise sources at several locations in the circuit. While differing in detail, the essential features of the output signal—with only one noise source acting—are found to be the same for each noise source in the circuit. An additional white-noise component, however, is contributed by the source across the output. The common features of the signal reveal two aspects of oscillator behavior to be present simultaneously, which heretofore have variously been assumed to exist separately, to the

exclusion of one another. The first one is characterized by the random-walk phase disturbance and low-frequency amplitude modulation, while the other is the action of the oscillator as an extremely narrow-band noise filter. The manner in which these aspects are reflected in the power density spectrum of the signal and its short-term frequency stability are discussed. Author

N66-10394* Varian Associates, Beverly, Mass.
SHORT-TERM STABILITY OF PASSIVE ATOMIC FREQUENCY STANDARDS
R. F. Lacey, A. L. Helgesson, and J. H. Holloway *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 8 p refs Prepared jointly with Varian Associates, Palo Alto, Calif. (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

The stability of passive atomic frequency standards is limited by shot noise introduced by the atomic reference. The contribution of shot noise to the frequency instability can be described in terms of a figure of merit for the atomic reference, and this figure of merit is used to compare references now existing and proposed. The figure of merit is calculated for atomic beam and vapor cell systems, and the asymptotic expressions for the rms frequency fluctuation for long and short averaging times are expressed in terms of it. Measurements of the rms frequency fluctuation of a cesium beam standard show the expected $T^{-1/2}$ dependence on averaging time and agree in magnitude with the calculated values. It is feasible to build atomic beam standards where the contribution of shot noise to the frequency fluctuation for averaging times less than 1 second is less than that due to the crystal oscillator. Rubidium vapor frequency standards currently meet this specification. Author

N66-10397* Raytheon Co., Bedford, Mass.
NOISE SPECTRUM PROPERTIES OF LOW-NOISE MICROWAVE TUBE AND SOLID-STATE SIGNAL SOURCES.
H. Mager, S. L. Johnson, and D. A. Calder (Raytheon Co., Wayland, Mass.) *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 12 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

Microwave signal sources, used as local oscillators and transmitter chain exciters in many of today's high-performance coherent tracking and guidance radars, require very low residual frequency or phase modulation. The modulation rates of the residual modulation of interest for these radars extend from 10 cps on out to 150 kc/sec. In this paper, experimental data are presented on the residual FM of low-noise L- to X-band tubes, "solid-state klystrons," and solid-state chains. The tube types include klystrons, magnetrons, and triodes. Data are presented on solid-state chains of the type consisting of a VHF crystal-controlled transistor oscillator, followed by a VHF transistor power amplifier and a varactor frequency multiplier chain. The spectral shape of the solid-state chain is shown to differ appreciably from those of the microwave tube sources and that of the solid-state klystron. The relation between the various parameters of the chain—such as the crystal Q and the amplifier noise figure, and the magnitude and spectral shape of the residual FM of low-noise solid-state chains—are discussed. Author

N66-10398* Westinghouse Electric Corp., Baltimore, Md.
SHORT-TERM FREQUENCY STABILITY MEASUREMENTS OF A CRYSTAL-CONTROLLED X-BAND SOURCE
J. R. Buck and D. J. Healey III *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 9 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50 (Contract NOw-63-0280-d)

A crystal controlled X-band source providing a high degree of spectral purity and 750 milliwatts power output was designed and evaluated. Results of the evaluation revealed that, when the oscillator is built to yield high spectral purity, the harmonic generator and transistor amplifier can limit the attainable purity at X-band. Results of measurements of spectral purity when the oscillator and harmonic generator are subjected to vibration environment are given. Author

N66-10399* General Radio Co., West Concord, Mass.
A LOW-NOISE PHASE-LOCKED-OSCILLATOR MULTIPLIER
H. P. Stratemeyer *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 5 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

A 100-Mc crystal oscillator can be phase-locked to any submultiple frequency between 1 and 10 Mc/sec. The use of a keyed phase detector makes it possible to obtain a wide range of multiplication ratios without adjustments of the circuit. Exceptional flexibility for experimental purposes and large multiplication ratios in a single stage are obtained with only moderate complexity. The bandwidth of the multiplier can be made over 5 kc/sec wide at 100 Mc/sec, so that the characteristics of the driving source are reproduced for averaging times down to less than 100 μsec. The noise level of the multiplier is less than −145 db per cps bandwidth at the 100-Mc output. Author

N66-10406* Collins Radio Co., Cedar Rapids, Iowa.
A TUNABLE PHASE DETECTOR FOR SHORT-TERM FREQUENCY STABILITY MEASUREMENTS
A. E. Anderson and H. P. Brower *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 8 p ref (See N66-10381 01-07) GPO: $1.75; CFSTI: MC $1.50

A test instrument for measuring the phase stability of quartz crystals under vibration was developed in 1961 on a Signal Corps contract. Since then it has proved to be a very useful device for the measurement of phase and short-term frequency stability of frequency-generating and frequency-converting circuits such as crystal oscillators, mixers, multipliers, dividers, and synthesizers. Consisting of a tunable phase detector and a reference crystal oscillator phase-locked to the average frequency of the test signal, the instrument covers the frequency range of 1 to 110 megacycles. The equipment resolution at 1 Mc is 0.001 degree in a bandwidth of 20 cps to 4 kc. This is equivalent to a sideband-level of −101 db or a short-term frequency stability of 3 parts in 10^{10} in a 10 millisecond measuring period. At 100 Mc, the resolution is 0.04 degree of a sideband level of −69 db. By use of a narrow-band audio spectrum analyzer, an additional 20 to 30 db of resolution can be obtained. A chart recorder in conjunction with the spectrum analyzer has made it possible to plot spectrum profiles of signals with sideband resolution of −140 db. Design considerations of the instrument are discussed, and measurement techniques and typical results are shown for several types of signal sources. Author

N66-10407* Bureau des Normes de l'Industrie Horlogere Suisse, Neuchatel.
SHORT-EFFECT INFLUENCE ON THE FREQUENCY OF AN OSCILLATOR LOCKED TO AN ATOMIC BEAM RESONATOR
P. Kartaschoff *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 6 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

For an oscillator—locked to the resonance of an atomic beam tube—the main source of short-term frequency fluctuations is, in most cases, the shot noise due to the atomic beam. Assuming

this to be white noise described by Schottky's formula, the spectral density of the controlled variable (i.e., of the instantaneous value of the controlled-oscillator frequency) is calculated for the case of a simple integrating servo loop having only one time constant. It is shown how the standard deviation of measured samples can be calculated by using a formula given by Mac Donald. For sampling times which are long compared with the servo time constant, an approximation leads to a simple formula which agrees better with the experimental results than the approximations which do not consider the response of the servo system. Author

N66-10414*# Research Triangle Inst., Durham, N. C.
MICROELECTRONICS IN SPACE RESEARCH
R. M. Burger Washington, NASA, Aug. 1965 131 p refs
(Contract NASr-236)
(NASA-SP-5031) GPO: HC $0.60; CFSTI: MF $1.00 CSCL 09A

Information on the contributions to the microelectronic field which have originated in NASA research programs is summarized. Also, a review of the status of microelectronics in which the limitations of the various technologies are highlighted is included. Considerable emphasis was placed on silicon integrated device technology because of its relative importance. Major subjects are technology and techniques, device design and development, reliability, and applications. E.E.B.

N66-10460# Oak Ridge National Lab., Tenn.
OPTIMIZATION OF SEMICONDUCTOR PREAMPLIFIERS FOR USE WITH SEMICONDUCTOR RADIATION DETECTORS
Theron Vaughn Blalock (Ph.D. Thesis—Tenn. Univ.) 23 Feb. 1965 36 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1055)

The input and filter sections of the nucleonic preamplifier, which determine the noise line width and the pulse shape, are considered. A literature survey of theoretical physical operation and noise characteristics of field-effect transistors is presented. A noise theory based on a power-law doping profile is developed. Design considerations for optimum input-section performance are presented. Expressions for pulse response and noise power spectral density are derived. Pulse geometry and signal-to-noise ratios of various filter sections are considered. Experimental results are presented and correlated with the design theory. NSA

N66-10625*# General Electric Co., Pittsfield, Mass. Ordnance Dept.
DESIGN AND MANUFACTURE OF DIRECT CURRENT TORQUER AMPLIFIERS Final Summary Report
D. W. Gilchrest and A. E. Schutz 30 Jul. 1965 31 p
(Contract NAS8-11876)
(NASA-CR-67791; FDU-65-8) CFSTI: HC $2.00/MF $0.50 CSCL 09C

A dc torquer amplifier was designed which uses pulse width modulation (PWM) to obtain a high power efficiency, but allows a continuous dc current to flow through the servo motor to minimize ac losses and heating. One breadboard and twelve operating modules were constructed which meet all specifications. The complete assembly (unpotted) has dimensions of 2.63 by 1.94 by 0.58 inches with all terminals and trim components contained within the envelope. Some of the advantages of this PWM circuit are that the dc gain of the amplifier is independent of load inductance or switching frequency. The maximum ac heating is reduced by a factor greater than four from previous PWM circuits, and the power supply requires less energy absorption capability since it does not receive a power kick-back from the load after each cycle. The torquer amplifier was operated with both an ST124 PIGA loop and an ST124 gimbal servo loop with air bearing gyro and gimbal simulator. Completely acceptable performance was obtained in both servo loops. R.N.A.

N66-10694# Princeton Univ., N. J. Plasma Physics Lab.
AC RESPONSE OF SPIRALLY WOUND CAPACITORS
F. H. Tenney Sep. 1965 20 p
(Contract AT(30-1)-1238)
(MATT-378)

The impedance of a spirally wound capacitor is calculated. The current distribution is determined as well. The capacitor is treated as a nested set of coaxial cylinders. It is found that at high enough frequencies the capacitor displays many characteristics of a transmission line. Author

N66-10727# Philips Gloeilampenfabrieken N. V., Eindoven (Netherlands).
THEORY AND EXPERIMENTS ON THE NOISE OF TRANSISTORS
A. Baelde (Ph.D. Thesis–Tech. Hogeschool, Delft, Oct. 1964) 1965 136 p refs *Its* Philips Res. Rept. Suppl. No. 4, 1965
CFSTI: HC $4.00/MF $1.00

The noise performance of transistors is studied, both theoretically and experimentally. In the theoretical study the noise associated with generation and recombination of injected minority carriers in the base region is investigated, assuming that the process occurs via one kind of recombination centers (Shockley–Read process). It is shown that the noise can be represented by the independent shot noise of a recombination current and a generation current, except for some specific situations. The representation is also allowed when the process is nonlinear, i.e., when the lifetime of the injected carriers depends on the injection level. However, in the latter case the auto- and cross-spectral densities of the short-circuit noise currents at emitter and collector of the so-called intrinsic transistor deviate from their values for a linear recombination process. The experimental work, carried out on germanium transistors at room temperature, generally bears out the theory based upon a linear recombination process, except for the noise conductance at low frequencies. Author

N66-10776# Texas Instruments, Inc., Dallas.
LOW-NOISE L-BAND TRANSISTOR Final Report, 15 May 1964–30 Jun. 1965
Doyle S. Granberry, R. L. Petritz, and Roger R. Webster 30 Jun. 1965 47 p refs
(Contract DA-28-043-AMC-00119(E))
(TI-03-65-61; AD-621532)

A research and development program is described for a germanium microwave low-noise amplifier transistor with a noise figure goal of 3.0 db and practical gain at 1.3 Gc. Final state-of-the-art samples averaged 3.1 db noise figure and 9.4 db gain. Technology work is described and the device design is discussed. Microwave testing is discussed and test results are given. Author (TAB)

N66-10786# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC INTEGRATION AND DIFFERENTIATION OF ELECTRIC SIGNALS

M. A. Rozenblat and O. G. Kasatkin 15 Jun. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 5, 1964 p 1066–1069
(FTD-TT-65-217/1+2+4; AD-621055)

This report discusses the application of the branched magnetic cores of ferromagnetic materials, with a rectangular hysteresis, to analog memory devices. TAB

N66-10805# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A CATHODE-RAY STORAGE TUBE
Z. G. Petrenko, L. I. Ionova, and N. V. Zelenskay 27 May 1965 6 p Transl. into ENGLISH of Soviet Patent No. 159193 (Appl. No. 801251/26-9, 3 Oct. 1962) 2 p
(FTD-TT-65-486/1+2; AD-620132)

The proposed cathode-ray storage tube differs from existing tubes with a visible potential relief by the possibility of obtaining not only a visible light signal which is stored for an extended period, but also its electrical analog. This is accomplished by using a target operating in an image iconoscope regime and introducing a readout gun. TAB

N66-10832# Army Electronics Labs., Fort Monmouth, N. J.
HOT-SPOT MESOPLASMA FORMATION IN SILICON PLANAR TRANSISTORS
E. B. Hakim Jun. 1965 17 p refs
(ECOM-2605; AD-621141)

A model is presented to explain the cause of mesoplasmas when secondary breakdown occurs in silicon planar transistors. An analysis of both aluminum and gold metalized devices is presented. To substantiate the model, data are presented from experiments using an electron microprobe and an infrared scanner, both used to analyze the second breakdown sites. Two areas of investigation are suggested which may prove effective in reducing the destructive effects of hot spots and mesoplasmas in transistors. Author (TAB)

N66-10847# Fairchild Semiconductor Corp., Palo Alto, Calif. Research and Development Labs.
UHF SMALL SIGNAL TRANSISTOR Fourth Quarterly Progress Report, 1 Feb.–15 May 1965
H. Wolf [1965] 103 p refs
(Contract DA-28-043-AMC-00040(E))
(Rept.-4; AD-621084)

This report covers principally the design, fabrication, and electrical evaluation of the final quantity of transistors made under this contract. The final shipment of transistors consists of 30 transistors in the stripline package and 70 transistors in a modified TO-18 package. A detailed analysis of all experimental data is given. All transistors meet or exceed the primary requirements on power gain, stability, and noise figure. This includes a gain figure greater than or equal to 37 db; unilateral gain greater than or equal 12 db ; stability factor between 0.7 – 1.5; and noise figure less than 6 db at 500 Mc at the operating level of 12 mW. Reliability data on units mounted in the stripline package is furnished; a further report will cover environmental tests on the modified TO-18 package.
Author (TAB)

N66-10870# ITT Federal Labs., Palo Alto, Calif. Shockley Labs.
RELIABILITY PHYSICS STUDIES ON TRANSISTORS Quarterly Status Report No. 1
W. Schroen Griffiss AFB, N. Y., RADC, Aug. 1965 63 p refs
(Contract AF 30(602)-3605)
(RADC-TR-65-141; AD-621075)

The report deals with failure mechanisms in silicon semiconductors. Investigations were made of surface breakdown phenomena in oxide protected silicon devices. The surface breakdown voltage of a diode can be altered by external illumination or by carriers moving in surface channels. The fact that a small photocurrent controls an avalanche current which is several orders of magnitude larger has been studied in three respects: The effect of the illumination itself, both with and without an additional gate around the diode under consideration, the effect of an adjacent diode located at a certain distance from the diode under study, with and without gate, and the effect of surface ion drift, again with and without gate. Further investigations are made of the second breakdown phenomenon in silicon power transistors. Diode structures have been used to observe the appearance of hot spots. Plasma breakdown in relatively large areas has been observed. The high temperature associated with the plasma was able to seriously damage the aluminum evaporated for contacting the diodes. TAB

N66-10889*# Smith Electronics, Inc., Cleveland, Ohio.
STUDY OF SHORT TERM PHASE STABILITY Interim Report, Mar. 17–Sep. 5, 1965
Robert A. Mostrom 6 Sep. 1965 20 p
(Contract NAS8-11592)
(NASA-CR-67705) CFSTI: HC $1.00/MF $0.50 CSCL 09A

The theory of frequency-changing with the charge-storage diode is attempted using Fourier harmonic analysis. Experimental work in the areas of frequency division, multiplication, and mixing is reported. The applicability of the Manley-Rowe relationships to subharmonic operation of the charge-storage diode is suggested. Matching and filtering techniques potentially useful for mixer and divider circuits using charge-storage diodes are discussed. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N66-10047*# General Electric Co., Daytona Beach, Fla. Electronic Simulation Unit.
SINGLE PARAMETER TESTING Final Report, Part III, Addendum
J. T. Sterling Sep. 1965 18 p refs *Its* Rept.-65-SIMAR-90/7
(Contract NAS8-11715)
(NASA-CR-67599) CFSTI: HC $1.00/MF $0.50 CSCL 09C

This Phase C extension study has established that single parameter testing using time sampling can be performed on non-linear systems. Certain non-linearities can be predicted by this technique. The range over which accurate parameter predictions can be made was the same for the testing of both the linear and non-linear model of the thrust vector control system. The accuracy of the parameter prediction was less for the non-linear system. The reason for this was the complexity of the system model, however, and not the fact that the system contained non-linearities. The system complexity led to problems in matching the nominal system to the actual system under zero parameter error conditions and problems in data repeatability. Author

N66-10112 Joint Publications Research Service, Washington, D. C.
TWO-DIMENSIONALLY PERIODIC MULTICONDUCTOR LINE CONTAINING N ROUND CONDUCTORS PER CELL
I. Sh. Beluga *In its* News of Higher Educational Inst. 28 Feb. 1964 p 165–190 refs (See N66-10101 01-23) CFSTI: $6.00

A method is proposed for calculating the wave-impedance, amplitude, spatial harmonics, and damping matrices in a two-dimensional periodic multiconductor line containing N round conductors per cell. The radii of the conductors are not assumed to be small, and the basis vectors of the two-dimensional lattice are assumed orthogonal. The method is based on the procedure developed for calculating two-dimensional electrostatic fields satisfying the Floquet conditions, and on the principle of the minimum of electrostatic energy. Results obtained are needed to calculate slow-wave systems by the method of multiconductor lines, and to calculate some long lines. Author

N66-10114 Joint Publications Research Service, Washington, D. C.
CONTRIBUTION TO THE THEORY OF TUBES WITH TRANSVERSE INTERACTION
R. A. Dudnik *In its* News of Higher Educational Inst. 28 Feb. 1964 p 215–237 refs (See N66-10101 01-23) CFSTI: $6.00

The dispersion equation is considered for a tube with transverse interaction, operating in the small-amplitude mode with a weak beam current. The gain of such a tube is calculated for sufficiently narrow slow-wave systems; comparison is made with a traveling wave tube of short length. Author

N66-10118 Joint Publications Research Service, Washington, D. C.
SYNTHESIS OF DISCRETE CONTROL SYSTEMS ON THE BASIS OF SETS OF ALGEBRAIC-LOGIC EQUATIONS WITH DELAY
M. Ya. Eyngorin *In its* News of Higher Educational Inst. 28 Feb. 1964 p 310–344 refs (See N66-10101 01-23) CFSTI: $6.00

Some forms of sets of algebraic-logic equations with delay are considered, describing autonomous and non-autonomous discrete devices with feedback. Physical models of these systems are given, which are equivalent in their functional properties to different counters, pulse generators, dynamic flipflops, and other devices. Author

N66-10125 Joint Publications Research Service, Washington, D. C.
POSSIBILITY OF USING THE METHOD OF QUATE SERIES FOR FORWARD AND BACKWARD WAVE MAGNETRON AMPLIFIERS
A. F. Golubentsev *In its* News of Higher Educational Inst. 28 Feb. 1964 p 387–389 refs (See N66-10101 01-23) CFSTI: $6.00

The characteristic equation for a magnetron amplifier is solved to determine the amplification coefficients for backward- and forward-wave amplifiers. The amplification coefficients are also expressed by a linear combination of amplitude functions. E.E.B.

N66-10126 Joint Publications Research Service, Washington, D. C.
CLOSED TRAJECTORIES IN RECIRCULATION REGISTERS WITHOUT INFORMATION SHIFT
M. Va. Eyngorin *In its* News of Higher Educational Inst. 28 Feb. 1964 p 390–393 ref (See N66-10101 01-23) CFSTI: $6.00

Closed trajectories in recirculation registers are considered for three particular cases and examples of different forms of the transition planes are shown as functions of two parameters. The possibility of obtaining in the transition plane several individual trajectories which can determine the switching of the memory elements in magnetic devices is explored and the construction of a variant of a recirculation register in which each closed trajectory has an active amplifier element is discussed. It is shown that in the case of individual closed trajectories, simulated by elements with rectangular hysteresis loop and transistors, the conversion of the memory elements from one stable state to the other can be carried out by means of total current considerations. E.E.B.

N66-10176# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATION Selected Articles
2 Apr. 1965 92 p refs Transl. into ENGLISH from Avtomatyka (Kiev), no. 6, 1963 p 3–10, 17–83
(FTD-TT-64-791/1+2; AD-615729)

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N66-10177 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD OF OPTIMIZATION OF THE TRANSIENT RESPONSE OF A SERVO-SYSTEM WITH A THIRD ORDER OSCILLATORY DRIVE
A. I. Sud-Zlochev'skiy and I. H. Ufimtsev *In its* Automation 2 Apr. 1965 p 1–9 (See N66-10176 01-10)

In optimizing the transient response of a servo-system with a third order oscillatory drive, the transient process is defined as the displacement of the controlled object along the controlled coordinate from an arbitrary initial position to a given position under the effect of a step input. Equations were derived for the dynamics of the drive and of the controlled object for the three intervals of the resulting error, and the theoretical

results obtained are presented. Time diagrams of oscillations of variables for zero-valued initial conditions are included, along with oscillograms of servo-system transients with and without optimal control, and a block diagram of the servo-system with a near optimal transient process. Simulation of the system showed that deviations in the drive parameters and in the duration of control signal intervals affect the curve of the transient process. However, it was found that even with deviations of ±20%, the quality of the transient process of the optimal system is superior to that of a system without optimal control. M.G.J.

N66-10178 Air Force Systems Command, Wright-Patterson AFB, Ohio.

APPROXIMATE EQUIVALENT FREQUENCY CHARACTERISTICS OF THE CARRIER COMPENSATING RLC NETWORKS

V. I. Gostyev *In its* Automation 2 Apr. 1965 p 10–23 refs (See N66-10176 01-10)

Approximate equivalent transfer functions are derived for the carrier RLC networks, and certain properties of these transfer functions are discussed along with features peculiar to the RLC networks. It was found that these approximate expressions may be used over a wide modulating frequency range, and for evaluating the respective equivalent logarithmic characteristics (ELC); use of the ELC method makes possible the synthesis of ac compensating circuits for the RLC networks at carrier frequency. It was also shown that approximate expressions obtained for complex transfer functions are the same as the exact expressions of normal transfer functions of their low frequency prototypes or of the low pass filters. This made it possible to find the approximate equivalent transfer function of a carrier frequency RLC–network from the corresponding low-frequency prototype transfer function. M.G.J.

N66-10181 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN PROBLEMS IN THE ANALYSIS OF OPTIMAL SYSTEMS OF AUTOMATIC STABILIZATION

L. M. Boychuk *In its* Automation 2 Apr. 1965 p 45–56 refs (See N66-10176 01-10)

Analysis of second order automatic stabilization systems with an optimum or near optimum speed of producing a step error signal showed that three basic system configurations can be obtained, depending on the method used for braking the output motor. The response times of these methods: reverse current, dynamic, and free running braking—were compared, with the loading effect on the response of each system considered. A rectangular mechanical characteristic of the motor, and a dry friction type of loading were assumed. Results indicate: (1) For loading moments corresponding to $\alpha > 0.5$, where α is the ratio of the actual moment of the load to the maximum moment of the motor, all control systems showed approximately the same time in producing the error signal. (2) Load effect on response speed is small for small error signals, both for $\alpha < 0.5$ in reverse current braking, and for $0.2 < \alpha_1 < 1.0$ in dynamic braking systems. (3) With large error signals, load effect may be neglected in reverse current braking systems for $\alpha < 0.5$ to 0.7, and in dynamic braking systems for $0.2 > \alpha_1 < 0.6$. (4) In free running motor systems, minimum response time corresponds to the load $\alpha = 0.5$. M.G.J.

N66-10182 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ANALYSIS OF ERRORS IN AN AUTOMATIC MOLTEN METAL METERING SYSTEM

A. D. Pushchalov'skiy *In its* Automation 2 Apr. 1965 p 57–65 refs (See N66-10176 01-10)

A system with only one programming method is considered, in which the rate of mold filling is given as a function of the weight of the metal cast. The programmed control satisfies only one technological requirement: when the metal is poured in small quantities out of a large capacity foundry ladle, the state of the system after one pouring operation is the start of the next cycle. Therefore, the system consists of an automatic zeroing circuit, and an output circuit of filling the molds according to the programmed speed. The static error recurring in metering out systems for molten metal is considered, and the static equations for the automatic zeroing circuit components and the output circuit OC elements are given. It was assumed that the component characteristics were stable and invariant during the pouring process. Pouring errors due to the ladle shape, and errors in the weight of one pouring due to quality control are also considered. An operating model was experimentally tested, and results show that the metering accuracy obtained in the pouring of granules was ±1% of the given weight of one pouring. M.G.J.

N66-10210# Joint Publications Research Service, Washington, D. C.

FINDING CRITICAL PATHS IN NETWORK SCHEDULES

V. S. Mikhel'son 8 Oct. 1965 10 p refs Transl. into ENGLISH from Ekon. i Mat. Metody (Moscow), v. 1, no. 2, 1965 p 256–261

(JPRS-32320; TT-65-32810) CFSTI: $1.00

An algorithm for determining the largest (critical) paths passing through given peaks of a multischedule was constructed. Among the problems considered were the correct ordered sequence of all peaks of the multischedule G: $T = (k_1, k_2, \ldots, k_{N_1})$. Algorithms for constructing the sequences T were given which permitted the detection of the presence of closed paths in G. Also considered were two paths beginning at a_1, passing successively through the peaks of the sequence A_j and terminating at k_i but not passing through the peaks of B. It was stated that the necessity and sufficiency of the first statement of the theorem was proven. Additional problems of the multischedule are also considered. R.W.H.

N66-10326*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A SINGLE-COLLISION MODEL FOR ELECTRON-BEAM CURRENTS BETWEEN PLANE ELECTRODES

Charles M. Goldstein and Arthur W. Goldstein Washington, NASA, Nov. 1965 23 p refs

(NASA-TN-D-3058) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Space-charge and potential distributions are calculated for the region between two plane electrodes. The effect of elastic, hard-sphere collisons between the electrons of the injected beam and the neutral gas molecules is incorporated into the analysis with the assumption that the electrons will suffer at most one scattering collision. The injected beam, itself, is assumed monoenergetic. Calculations of current as a function of voltage are compared with results from a multiple-collision model; very good agreement is found for an electrode-spacing to mean-free-path ratio of 0.1, and a maximum deviation of only 1.5 percent was observed for a ratio of 0.5. Current-voltage characteristics are also calculated for various values of emission current and electrode spacing. Collisions are found to have a pronounced influence on potential and density distributions, current, and region of time-independent operation. Author

N66-10461# Academy of Sciences (USSR), Moscow. Radiotechnical Inst.
CERTAIN THEORETICAL PROBLEMS OF WIDE-BAND OSCILLATORS
F. A. Vodop'yanov 1964 80 p refs In RUSSIAN
(NP-15209) CFSTI: HC $3.00/MF $0.75

Expressions are obtained for the quantitative estimation of the nonlinear frequency correction, the influence of nonlinear and parametric effects on the reactive elements, parametric and Schottky frequency fluctuations, the dependence of frequency on the rate of modulation of parameters, and the filtering properties of the auto-oscillator. The analysis is carried out by the method of integral equations and statistical treatment of the reactions of the auto-oscillator on a delta pulse of the anode current. Author (NSA)

N66-10576# Stanford Univ., Calif. Microwave Lab.
MICROWAVE DEVICE TECHNIQUES FOR AEROSPACE SURVEILLANCE Semiannual Contract Status Report, 1 Nov. 1964–30 Apr. 1965
Marvin Chodorow Griffiss AFB, N. Y., RADC, Aug. 1965 47 p refs
(Contract AF 30(602)-3595)
(ML-1349; RADC-TR-65-348; AD-470545)

The objective of this contract is to study solid state bulk effects including microwave acoustics with the view of the application of such effects toward variable delay and/or amplification devices. Author (TAB)

N66-10798# Texas Technological Coll., Lubbock.
A TOPOLOGICAL METHOD OF SYNTHESIS FOR A CLASS OF BIQUADRATIC INPUT IMPEDANCE FUNCTIONS
Reagan H. Beene, Jr. (Ph.D. Thesis) Aug. 1965 62 p refs
(Contract AF 33(608)-1119)
(AD-620398)

Topology is applied to one of the areas of the synthesis of biquadratic impedances, namely impedances realizable with an arbitrary number of resistors and not more than two storage elements. The method of residual networks forms the basis of the method of synthesis. The networks are assumed to be linear, passive, lumped, and bi-lateral. TAB

N66-10856# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PROPOSED ELECTRONIC SYSTEMS FOR THE LES RADIATION EXPERIMENT (SEPTEMBER 1964)
J. H. Binsack 20 Jul. 1965 89 p refs
(Contract AF 19(628)-5167)
(TN-1965-5; ESD-TDR-65-54; AD-619977)

To study the electron radiation environment of the Lincoln Experimental Satellite (LES), an electron detecting telescope has been proposed by C. Mack, et al. This report presents the proposed electronic system for this radiation experiment. This system is the result of a summer study by the author. The logical design on the electronic system is based on the use of a 'hybrid counter' as the scaler. The 'hybrid counter' employs the best features of both the 'fixed time' and the 'fixed count' scalers and can operate over a wide range of counting rates. Coincidence logic is programmed within the experiment so that the telescope can monitor the electron flux for energies from 60 Kev to 10 Mev with counting rates from 100 000 counts/sec down to 0.1 count/sec. The design of a charge sensitive solid state preamplifier and measurement chain is detailed. The integrating and differentiating time constant is set at 0.5 micro sec, and a noise linewidth of 27 Kev (fwhm) is achieved at 30C with a simulated input capacitance of 100pf. Author (TAB)

N66-10862# Illinois Univ., Urbana. Coordinated Science Lab.
NETWORK SYNTHESIS TO MINIMIZE MULTIPARAMETER SENSITIVITY
Samuel Chien-hsun Lee Aug. 1965 179 p refs
(Contract DA-28-043-AMC-00073(E))
(R-262; AD-619726)

The concept of sensitivity group is introduced in giving a new definition of multiparameter sensitivity which is more general than that of Goldstein and Kuo. Some theorems on the multiparameter sensitivity for RLC network are given. From these theorems, the sensitivity groups of any RLC network can be directly determined from the network. The multiparameter sensitivity of any RLC network can thus be easily obtained. The new definition makes it possible to compare two RLC networks of different topology realizing the same network functions with respect to multiparameter sensitivity. In particular, RC ladder networks are compared with non-series parallel structures which are synthesized by an extension of a procedure due to H. B. Lee. It is shown that the new networks always have smaller values of multiparameter sensitivity than two classes of equivalent ladder networks. Numerical examples computed on CDC 1604 and IBM 7094 are given to illustrate the method. Author (TAB)

N66-10922# California Univ., Berkeley. Electronics Research Lab.
THE EFFECT OF CROSSED MAGNETIC FIELD ON POTENTIAL MINIMUM STABILITY
Raymond Yue Chung Ho 13 Jul. 1965 65 p refs
(Contract DA-36-039-AMC-02164(E))
(Rept.-65-20; AD-470633)

Guns used to produce beams for crossed-field microwave amplifiers can be broadly divided into two categories: long and short. If the width of the cathode in the direction normal to the magnetic field is small in comparison with a cycloid length, the gun is called 'short'. Many practical guns, especially for high-power devices, have cathode widths which are comparable with, or even much larger than, a cycloid length. These 'long' guns have been found to produce a beam with much greater broadband noise when operated spacecharge limited. In this paper we wish to construct a simple spacecharge feedback model for studying the noise phenomena in the space-charge-limited condition as a two-dimensional problem in a long gun as well as a short gun from the viewpoint of potential minimum instability. The noise analysis for the spacecharge-limited ordinary diode is included to provide a simplified introduction. It indicates a spacecharge smoothing of shot noise and we have used it as our limiting case, so as to check our model and calculations. A method for considering current sorting and beam-current perturbation in an M-type gun is discussed. A simple two-dimensional feedback model based on a set of fixed trajectories is presented. The calculations from this model show no instability of the potential minimum. Suggestions have been made for furthering this work to find a theoretical model which explains experimental results. Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N66-10091 Oak Ridge National Lab., Tenn.
A PORTABLE METALLOGRAPHY LABORATORY
R. S. Crouse *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 129–136 (See N66-10076 01-15) CFSTI: $5.00

During the fabrication of large reactor components need for on-the-spot metallographic examination became apparent. The components were bulky and difficult to move to a central metallography lab. Although they were too valuable to be cut into small sections, it was permissible for specific areas to be ground and polished in situ for examination. These restrictions on standard metallographic procedures required that some means of polishing, etching and examining be devised to cope with these situations. This report deals with two specific instances, the ways in which they were handled, and the portable kit which evolved. Author

N66-10235* Radio Corp. of America, Princeton, N. J.
SPACECRAFT ENVIRONMENTAL TESTING
W. Schreiner, R. Newman, M. Gittler, and S. Rummel *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 191–205 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1272)

Physical tests were performed on Relay I to approximate the environment and stress which would occur during handling, launch, and orbital flight. Temperature, humidity, vibration, shock, pressure, sand and dust, salt spray, fungus, solar radiation, and rain are discussed in terms of long-term earth events. Aerodynamic and propulsion sources of temperature, vibration, acoustic noise, shock, spin, acceleration, and vacuum conditions are considered for events associated with the spacecraft launching. Temperature, vacuum, charged particle radiation, and micrometeroids are the factors of concern during orbital flight. The various qualifications tests performed include spin, temperature, vibration, solar simulation, humidity, thermal gradient, and steady state acceleration. Acceptance tests were made for spin, temperature, solar simulation, and vibration; and the vibration acceptance test inputs are tabulated. M.W.R.

N66-10236* Radio Corp. of America, Princeton, N. J.
GROUND SUPPORT EQUIPMENT
W. Schreiner, R. Newman, and M. Gittler *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 207–225 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1272)

Spacecraft checkout equipment, environmental simulation facilities, and handling fixtures made up the ground support equipment for Relay I; microwave repeater checkout provides for transmission and reception of video test signals to determine differential phase, differential gain, and low and high frequency characteristics. Since much of the Relay testing was concerned with reduction of telemetry data, a relatively complete telemetry decommutation station was used for the checkout studies. A pulse synchronizer, test generator, word sync and recognition unit, analog and digital word selectors, and a binary decimal converter were used in the telemetry studies. Command checkout equipment is also discussed. A solar simulator, which approximates duplicate incident solar energy flux and spectral energy distributions, utilized two 13.6 mm high-intensity carbon arc lamps. System layout is shown and output measurements are discussed. Handling procedures and fixtures for the Relay spacecraft are concerned with vertical and horizontal lifting fixtures, work stand, bird cage, and shipping container. M.W.R.

N66-10240* Space Technology Labs., Inc., Redondo Beach, Calif.
G SFC RELAY COMMUNICATIONS SATELLITE TEST STATION
T. H. Guerin, R. G. Slaughter, and W. C. Wray *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 289–328 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1302)

An overall system description and implementation are considered for the two Relay communications satellite test stations, located at Nutley, N. J., and near Goldstone, Calif. These stations, which are equipped for satellite checkout and for TV transmission and reception, can command control, monitor spacecraft telemetry, and conduct communications experiments at the direction of the Relay Operations Center at Greenbelt, Md. Telemetry, command, wideband communications transmitter, communications receiver, video, frequency-division multiplex telephone, and the antenna and tracking systems are described for the test stations. Test station mobile trailers are shown and various equipment layouts are diagrammed. M.W.R.

N66-10247* Bell Telephone Labs., Inc., Murray Hill, N. J.
THE ANDOVER GROUND STATION
A. Klute *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 469–476 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1987)

To provide means for transmitting and receiving from communications satellites, the Andover, Me. ground station is equipped with communications antenna, transmitting and receiving equipment, coupling circuitry, satellite tracking equipment, and means for programming the antenna to track the visible portion of the satellite's orbit. Descriptions and illustrations are offered for the equipment; and site selection is discussed. M.W.R.

N66-10249* ITT Federal Labs., Nutley, N. J.
THE NUTLEY GROUND STATION
B. Cooper and R. Mc Clure *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 515–524 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-2056)

An existing space communications research station was modified to meet the requirements of the Relay project, and a description is offered of the six major equipment areas: transmitter, communications receiver, terminal equipment, antenna and tracking system, coordinating facilities, and special test equipment. Major specifications are included for all the internal test equipment located at the ground station, which includes a 10-kw transmitter, a 40-ft paraboloidal antenna with Cassegrainian feed system, and a radio-frequency equipment pod located near the apex of the primary reflector. New equipment designs have been combined in the development of a transportable ground station capable of supporting a medium-capacity satellite system such as Relay. M.W.R.

N66-10252* Companhia Radio Internacional, Rio de Janeiro (Brazil).
RIO DE JANEIRO SPACE COMMUNICATIONS STATION
J. C. Fonseca and C. H. Moreira *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 561–574 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

The Rio de Janeiro Space Communication Station is being used to conduct two-way telephone, teletype, and data trans-oceanic experimental communications by satellite, between North America, Europe, and South America. The Station can handle two-way, 12 simultaneous telephone conversations or 12 teleprinter of high speed data per voice channel, or 144 total circuits whenever speech is not being transmitted. This chapter describes the general station setup, the general design of the equipment, and operational procedures. Author

N66-10253* Centre National d'Etudes des Telecommunications, Issy les Moulineaux (France).
THE PLEUMEUR-BODOU SPACE COMMUNICATIONS STATION
M. J. Dautrey *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 575-596 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

Overall design, facilities, and operational equipment are discussed for the Pleumeur-Bodou space communications ground station in France. This station has a one-way television and 300-channel telephony and a two-way, 12-channel telephony. Its antenna is a horn reflector; and the single-tuned ruby maser, which serves as a receiver, is connected to the antenna by the diplexer. Link performance, acquisition, tracking, telemetry, command, and operations problems can be investigated by this ground station which is also capable of adaptation to commercial operation. M.W.R.

N66-10255* Deutsche Bundespost, Darmstadt (West Germany).
THE RAISTING SPACE COMMUNICATIONS STATION
E. Dietrich et al *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 633-640 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

Equipment is described for the narrowband and wideband installations at the Raisting space communications station in Germany. Transmitter and receiver systems, antenna, and antenna pointing are considered for both installations; the automatic helium set-up required for the 24-hour operation of the maser in the wideband installation is discussed. Power supply for the ground station is located in the central building. M.W.R.

N66-10258* Kokusai Denshin Denwa Co., Ltd., Tokyo (Japan).
THE KDD SPACE COMMUNICATIONS STATION
In NASA. Goddard Space Flight Center Relay I Program 1965 p 657-661 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

A general description is given of the Kokusai Denshin Denwa space communications station in Japan; and the antenna system, transmitting and receiving equipment, and tracking facilities are discussed. The antenna steering digital controller, which contains parametrons as its stable logical elements, controls communications and tracking antennas at the earth station. Main part of the controller is an antenna steering computer, which uses a binary decimal external code and an excess three internal code. Details of this computer are included. M.W.R.

N66-10260* General Post Office, London (England).
THE GOONHILLY DOWNS SPACE COMMUNICATIONS STATION
W. J. Bray, F. J. D. Taylor et al *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 671-751 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

A series of papers deals with the Goonhilly Downs space communications station in Great Britain. The station and its facilities are described; including the steerable dish aerial, the main control building and computer and control rooms, power supply, and system checking facilities. Design requirements and considerations are given for the 85-ft steerable dish aerial; and discussions are included of the dish and supporting structure, azimuth mount, elevation mechanical drive, and control system. Calibration and testing procedures are presented. Computing and data transmission for prediction steering of the aerial are discussed. Other papers deal with beam-swinging facilities of the aerial, the circularly-polarized diplexer for the aerial, and primary aerial feeds. The waveguide feeder system, the 1700 mc transmitter, kow temperature thermal noise source, helium system of the maser installation, demodulating techniques, the traveling wave maser amplifier, and digital techniques used in aerial steering are also reported. M.W.R.

N66-10481# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SCHLIEREN SYSTEM FOR THE GRUMMAN HYPERSONIC SHOCK TUNNEL—THEORY AND DESIGN
Arnold Johnson Apr. 1965 38 p refs
(RM-272)

This report reviews a few of the important parameters that must be considered in the design of a schlieren system for use with the low density flows associated with a shock tunnel. The system that evolves from these considerations is of the single pass, parallel light variety which utilizes two large field lenses. This system is now in operation with the Grumman Hypersonic Shock Tunnel. Author

N66-10553*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 5, NO. 17
15 Sep. 1965 24 p
(NASA-TM-X-56876; X-537-65-217, Vol. 5, No. 17) CSCL 16B

Data computed and compiled as of 1200Z on September 15, 1965 are tabulated to include object, code name, catalogue number, source, launch date, period, inclination, apogee, perigee, and transmitting frequency where appropriate. Also, decayed objects are included. E.E.B.

N66-10556# General Electric Co., Philadelphia, Pa.
BIOSATELLITE SYSTEM QUALIFICATION TEST PLAN FOR THE RADIATION AND GENERAL BIOLOGY SPACECRAFT Test Plan
F. Smith, Jr. 9 Jul. 1965 59 p
(DOC.-65SD749)

The overall test plan for the system qualification of the spacecraft are outlined. The tests are designed to demonstrate and verify the integrity of the vehicle to perform properly and withstand the simulated environments of a three-day mission profile. The qualification tests will be initiated following the completion of an end item acceptance test of the vehicle at the system level. Environments, objectives, requirements, preliminary sequence check, measurement tolerances and accuracy, documentation, failure procedures, and schedules are included. E.E.B.

N66-10597# Comitato Nazionale per L'Energia Nucleare, Frascati (Italy).
ADONE: THE FRASCATI 1.5 GE V ELECTRON POSITRON STORAGE RING

30 Aug. 1965. 11 p. refs. Presented at the 5th Intern. Conf. on High Energy Accelerators, Frascati, Italy, Sep. 1965. *Its* Nota Interna No. 285
(LNF-65/26) CFSTI: HC $1.00/MF $0.50

The design and operations of the Frascati 1.5 GeV electron positron storage ring are briefly described. The ring is a strong focusing, separated function machine, with 12 equally long straight sections. Included in this status report are discussions and diagrams of the magnet, injector, vacuum system, and RF system. G.A.L.

N66-10602*# Westinghouse Electric Corp., Baltimore, Md. Defense and Space Center.
NASA INDUSTRIAL APPLICATIONS STUDY. INDUSTRIAL REVIEW FOR FILAMENT-WOUND PLASTIC, HIGH-VOLTAGE TRANSMISSION TOWER
R. N. Sampson. 4 Dec. 1964. 12 p
(Contract NASw-952)
(NASA-CR-67797) CFSTI: HC $1.00/MF $0.50. CSCL 13M

This discussion described the opportunity to apply existing data generated by NASA to the design and development of a high-voltage transmission tower made of filament-wound plastic. A plastic tower probably cannot compete in cost with conventional steel tower construction, but it can compete if advantage is taken of the properties which plastics possess that are superior to the metals. For this reason, careful design and economic studies are critical to the success of the project. Once feasibility is shown, the engineering details are solvable. Such a program would result in other desirable effects. The program data and technology would be directly applicable to low-voltage distribution poles, street lighting standards, and plastic bushings and insulators. It would also be applicable to radio, television, and microwave antenna structures. Author

N66-10633*# Massachusetts Inst., of Tech., Cambridge. Alfred P. Sloan School of Management.
RESEARCH PROGRAM ON THE ORGANIZATION AND MANAGEMENT OF RESEARCH AND DEVELOPMENT. QUESTIONING THE COST/EFFECTIVENESS OF THE R AND D PROCUREMENT PROCESS
Edward B. Roberts. Sep. 1965. 27 p. refs. Presented at the 2d Conf. on Res. Program Effectiveness, Office of Naval Res., Washington, 28 Jul. 1965
(Grant NsG-235)
(NASA-CR-67766) CFSTI: HC $2.00/MF $0.50. CSCL 14A

Presented are results of a cost/effectiveness evaluation of the Research and Development procurement process which controls the awards of over $8 billion annually of government sponsored research and development contracts to industry, universities, and nonprofit organizations. Analyzed are data received via brief questionnaires which asked the following questions: (1) Who are the winners of research and development contracts? (2) What are the key determinants of the awards to these winners? (3) Compared with possible alternatives, what are the benefits of the present R&D procurement process? (4) Compared with possible alternatives, what are the costs of the present R&D process? S.C.W.

N66-10635*# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.
RESEARCH PROGRAM ON THE ORGANIZATION AND MANAGEMENT OF R AND D. PROBLEM SOLVING STRATEGIES IN PARALLEL RESEARCH AND DEVELOPMENT PROJECTS
Thomas J. Allen. Jun. 1965. 28 p. refs
(Grant NsG-235)
(NASA-CR-67767) CFSTI: HC $2.00/MF $0.50. CSCL 14A

Three pairs of parallel R&D projects are examined. The data analyzed were gathered by means of Solution Development Records—a form which provides a weekly estimate of the probability of adoption of the approaches under consideration as possible solutions to a technical problem. It is found that the longer an approach is indicated by these forms to be in a favored position, the more difficult it is to reject. Furthermore, the number of alternative technical approaches considered bears a relation to judged solution quality. Groups producing higher-rated solutions generated fewer approaches during the course of the project, and they more closely approach an ideal strategy of approaches off on a two-at-a-time basis than do their poorer performing rivals. Author

N66-10845# Ohio State Univ., Columbus. Aerodynamic Lab.
AN ELECTRON BEAM DEVICE FOR REAL GAS FLOW DIAGNOSTICS
S. L. Petrie. Wright-Patterson AFB, Ohio, ARL, Jun. 1965. 50 p. refs
(Contract AF 33(657)-11060)
(ARL-65-122; AD-621574)

An electron beam device suitable for use in low density, non-radiating flows is described. It is shown that in certain ranges of gas density the electron beam can be employed to determine the rotational temperature, vibrational temperature and concentration of molecular nitrogen in a high speed air flow. The theoretical analysis required for interpretation of the data obtained with an electron beam is presented and examples of application of the technique are given. Certain design criteria for electron beam generators are discussed. Author (TAB)

N66-10866# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SUPERSONIC AXISYMMETRICAL NOZZLE FOR WIND TUNNELS
L. N. Kopp, A. S. Sokolov et al. 29 Jun. 1965. 6 p. Transl. into ENGLISH from Soviet Patent no. 131125 (Appl. no. 646532/25, 7 Dec. 1959). 2 p
(FTD-TT-65-223/1+2+4; AD-620074)

For the purpose of lowering the thermal stresses and temperature deformations which distort the configuration of the flow part the uncooled nozzle is designed in bracket fashion. TAB

N66-10924# ARO, Inc., Arnold Air Force Station, Tenn.
LAUNCHER OPTIMIZATION STUDIES
A. J. Cable, J. R. De Witt, and M. D. Prince. Arnold Eng. Develop. Center, Oct. 1965. 32 p. refs
(Contract AF 40(600)-1200)
(AEDC-TR-65-204; AD-471849)

An effort was made to determine launch cycles involving minimum peak acceleration for a given muzzle velocity for a 1.0-in. (25.4-mm)-caliber launcher. These launch cycles were checked experimentally, and a second set of cycles was established with the aim of further reducing peak accelerations. Launch cycles were developed for projectile weights ranging from 0.011 to 0.066 lbm (5 to 30 gm) and for launch velocities from 8000 to 19 000 ft/sec (2.4 to 5.8 km/sec). In general, the peak accelerations in these cycles do not exceed twice the constant-base-pressure accelerations for the given launch velocity. The closest approximation to constant base pressure was achieved with a 5-gm projectile launched at 17 000 ft/sec

(5.18 km/sec), where the maximum variation from constant acceleration was 27 percent. Predicted and experimentally determined launch cycles were compared, and it can be concluded that theory and experiment disagree markedly. However, with judicious allowances for weakness inherent in the computer programs, the theory is useful in developing constant-base-pressure or minimum acceleration launch cycles.
Author (TAB)

N66-10950# Woods Hole Oceanographic Institution, Mass.
THE CONSTRUCTION OF A ONE METRE DIAMETER ROTATING TABLE
Alan Ibbetson and Robert E. Frazel Aug. 1965 24 p
(Contract Nonr-2196(00))
(Rept.-65-41; AD-619682)

The design and construction of a rotating table one meter in diameter, which is capable of steady rotation at speeds continuously variable up to 100 rpm, is reported. The control equipment associated with the rotating table is described, and special apparatus and techniques used in observing phenomena occurring on the table are discussed. Details are given of the procedure used in the precise alignment of the rotation axis of the table with the vertical.
Author (TAB)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N66-10169# General Electric Co., Philadelphia, Pa.
SOME EXACT RELATIONSHIPS AT A FREE REAR STAGNATION POINT
M. Lenard Oct. 1965 24 p *Its* Fluid Mech. Component Fundamentals Memo No. 109

An expansion procedure is presented which permits establishment of a series of relationships based on the Navier–Stokes equations in the vicinity of a (free) rear stagnation point for a viscous compressible fluid. The results indicate that, in the limit of a very high Reynolds number, the relationships differ from those for inviscid flow due to the presence of heat conduction. Relationships are given which permit interpretation of these results in a curvilinear coordinate system based on the shape of the streamlines and in terms of a conventional rectangular coordinate system as well.
R.R.D.

N66-10183 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD OF APPROXIMATING THE CHARACTERISTIC EQUATION OF AN AUTOMATED GAS MAIN
D. B. Bayasonov *In its* Automation 2 Apr. 1965 p 66–80 refs (See N66-10176 01-10)

The problem of approximating the characteristic equation of a long-distance gas transportation system by means of approximating the equations of gas flow rate and gas stream continuity is examined. The analyzed system is a symmetrical gas main (with respect to the compressor station), having equally loaded sections of piping between the compressor stations. The sections have the same length and diameter of the pipes, and it is assumed that every compressor station has only one gas engine compressor type. Also considered are the cases of a constant gas pressure drop and of an arbitrary gas pressure drop between the inputs and outputs of the pipeline compressor stations. The characteristic equations are expressed, and it is pointed out that the approximations of gas main sections contained between two compressor stations, by equivalent sections with lumped capacities, result in mathematical expressions which are relatively easy to analyze. Irrespective of the gas pressure drop at the input and output of compressor stations, the obtained equations are polynomials in terms of the numerical values of the system constants; the transients in the systems of the gas main may be analyzed by control system theory methods.
M.G.J.

N66-10221# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATIONARY WORKING CONDITIONS OF A SUPERSONIC GAS EJECTOR
I. G. Portnov 3 Jun. 1965 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk (Moscow), no. 4, 1957 p 106–109
(FTD-TT-65-153/1+2; AD-620120)

The operation of a gas ejector in supercritical conditions of outflow of an active gas in the presence of a surface dividing the streams at the initial section of the blending chamber is under study. It was stated that outside of the cylindrical blending chamber the movement of ideal gases was uniform and stable. It was noted that at the initial section of the blending chamber the total pressure and mass of each gas remained unchanged, and the heat exchange through the walls was absent. The value of the ratio of specific heat $k = s_r/s_v$ for active gas coincided with the value k for passive gas. Finally, in view of the special selection of the Laval nozzle configuration, the effect of the intersection of rarefaction waves was not feasible and, therfore, there was a section of equal pressures in which the movement of each gas was considered monodimensional.
R.W.H.

N66-10331*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPTIMIZED TURNING-VANE DESIGN FOR AN INTAKE ELBOW OF AN AXIAL-FLOW COMPRESSOR
S. Z. Pinckney Washington, NASA, Nov. 1965 29 p refs (NASA-TN-D-3083) CFSTI: HC $2.00/MF $0.50 CSCL 20D

The results of the development of an elbow turning-vane design which produces both a high recovery and a uniform distribution at the exit of a 90° intake elbow of an axial-flow compressor are presented. The elbow exit flow angle did not exceed approximately 10° and an average total-pressure loss coefficient between 0.245 and 0.279 was obtained for the elbow inlet Mach number range 0.175 to 0.483.
Author

N66-10335*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATTENUATION OF SINUSOIDAL PERTURBATIONS SUPERIMPOSED ON LAMINAR FLOW OF A LIQUID IN A LONG LINE
Carl M. Holland, Robert J. Blade, and Robert G. Dorsch Washington, NASA, Nov. 1965 24 p refs
(NASA-TN-D-3099) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The attenuation constant for sinusoidal pressure and flow perturbations superimposed on the laminar flow of a viscous liquid was measured in a system consisting of a long, straight, cylindrical hydraulic line. The upstream and downstream ends of the line were securely fastened to the ground. A sinusoidal perturbation was imposed on the mean flow at the upstream end by means of a small oscillation of a throttle valve about a partly open mean position. The downstream end was terminated in a restricting orifice. Pressure perturbations were

measured at three locations along the line for frequencies from 15 to 100 cps. These pressure measurements were reduced by use of a pair of complex damped acoustic one-dimensional wave equations to obtain the attenuation constant along with the phase constant and the dimensionless downstream admittance. For the range of frequencies investigated, the experimental values of the attenuation constant are in good agreement with classical theory. Author

N66-10347# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE REFLECTION OF A SHOCK WAVE AT A SURFACE
Sinclaire M. Scala and Paul Gordon Jun. 1965 43 p refs (R65S024)

In this paper, a new finite difference method is employed for the first time in obtaining numerical solutions for the complete Navier-Stokes equations. The physical problem treated is the time-dependent propagation of a one-dimensional disturbance, which is produced by the forward motion of a piston through a compressible, viscous, thermally conducting, perfect diatomic gas and its subsequent reflection at a material surface. Two values of disturbance strength are considered, including weak and strong shock waves. The quantities determined include the variation of gas velocity, pressure, density and temperature as a function of time and distance. In addition, the heat transfer rate and the pressure, which are of considerable interest in the interpretation of shock tube phenomena, are determined at the surface during the period of reflection of the shock wave. Author

N66-10378# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.
APPROXIMATE COMPUTATION OF UNDEREXPANDED JET STRUCTURE
F. A. Albini Feb. 1965 31 p refs
(Contract ARPA SD-50)
(IDA-HQ-64-3230; P-162; AD-619777)

An investigation of the structure of a jet which exhausts at a pressure very much greater than the ambient pressure is carried out by an approximate analysis. This analysis has application in the description of the structure of a rocket exhaust at ionospheric altitudes, and of laboratory jet facilites of extreme pressure ratio. TAB

N66-10522# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (West Germany). Institut für Theoretische Gasdynamik.
TWO-DIMENSIONAL SUPERSONIC FLOW WITH RELAXATION [EBENE STROMUNG MIT RELAXATION]
F. Bartlmä Jul. 1965 32 p refs In GERMAN; ENGLISH summary
(DVL-442; DLR-FB-65-34) CFSTI: HC $2.00/MF $0.50

Supersonic wind-tunnel expansions occur so rapidly that thermodynamic equilibrium cannot set up. During expansion the water vapor in the air is supercooled, and the supersaturated state suddenly collapses on a short distance in flow direction. The disturbance marking the collapse is customarily called a condensation shock. A two-dimensional treatment of this process by the method of characteristics is presented as an example for the motion of a relaxing gas. Author

N66-10544# Technische Hochschule Stuttgart (West Germany).
EVALUATION OF EJECTOR APPARATUS FOR DIFFERENT MEDIA [AUSLEGUNG VON STRAHLAPPARATEN FUR BELIEBIGE MEDIEN]
Bernhard Bauer (Ph.D. Thesis) 1965 146 p refs In GERMAN CFSTI: HC $4.00/MF $1.00

Described is a graphical procedure to find the flow diagrams of various fluids, gases, and vapors in their optimal application for ejection machines. Evaluated were acceleration velocites before mixing, the constant or fluctuation cross sections of the mixtures, and the flow slowdown and diffusion. Also considered were the additional non reversible flow values in the nozzle, in the mixing duct, and in the diffuser. Calculations on the mixing of a fluid with a gas under evaporational conditions are presented. G.G.

N66-10546# Technische Hochschule Stuttgart (West Germany).
ON THE KINETICS OF STEAM BUBBLES IN PROPANE [UBER DIE DYNAMIK VON DAMPFBLASEN IN PROPAN]
Wolfgang Wanninger 1964 68 p refs In GERMAN CFSTI: HC $3.00/MF $0.75

The kinetic energy in the propagation and rise of vapor bubbles in liquified propane was studied by thermoelements, and by photographic observations at a temperature range of 20° to 75°C, and at pressures from 8.5 to 29 atmospheres. Bubble sizes increased slowly at the relative motionless formation stage and expanded during the rising stage linear with traveling time. Heat transfer values reached their maximum at the highest temperatures and were followed by a drastic decrease to the null value at the critical point. G.G.

N66-10670*# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
ELECTRON COLLISION CROSS SECTIONS IN METAL VAPORS Semiannual Report
J. F. Nolan and N. S. Emmerich 19 Aug. 1965 34 p refs *Its* Rept.-65-1E5-MHDIN-R1
(Contract NAS3-7100)
(NASA-CR-54474) CFSTI: HC $2.00/MF $0.50 CSCL 20D

The Townsend α coefficient has been measured in cesium–helium mixtures as a function of E/p, the ratio of electric field to total pressure, and N_{Cs}/N_{He}, the ratio of cesium to helium density. By comparing the observed α with that obtained from a numerical solution of the Boltzmann equation using an assumed cesium excitation cross section, one obtains a cross section consistent with these measurements and with previous measurements of the cesium ionization cross section. An excitation cross section with a peak value of 1.15×10^{-14} cm^2 at 8 eV gives good agreement with experiment. Author

N66-10695# British Aircraft Corp., London (England).
THE FLOW OF TURBULENT INCOMPRESSIBLE TWO-DIMENSIONAL JETS OVER VENTILATED CAVITIES, PAPER 33
John R. C. Pedersen [1965] 12 p refs Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, 8-9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

A flow model is presented which leads to a simple analysis for the shape of a curved two dimensional jet reattaching to an offset inclined wall, when the cavity beneath the jet is ventilated. Experimental results which support the analysis are also presented; good agreement is shown for ventilation flow rates up to some 15 percent of the main jet flow. For larger relative ventilation the momentum of the ventilating flow becomes significant but due allowance can be made for this. The results are significant in forming one step towards ability to calculate the performance of fluid logic devices. Author

N66-10696# Washington State Univ., Pullman.
GRAPHICAL SOLUTION FOR BRANCHING PIPE FLOWS
Claud C. Lomax 27 Jun. 1964 16 p Prepared for GE Hanford Atomic Prod. Operation
(Contract AT(45-1)-1350)
(HW-SA-3632)

A graphical procedure leading to a direct solution of flow distributions and pressure losses in complex branching pipes is presented. An example is given in which both inputs to the system, and draws from the system vary with the pressure. Author

N66-10716# Hanford Atomic Products Operation, Richland, Wash.
PRESSURE DROP CHARACTERISTICS OF TWO ECCENTRICALLY POSITIONED ORIFICES IN SERIES. I: EFFECT OF ECCENTRICITY, SPACING OF ORIFICES AND OF THE ORIFICE TO PIPE DIAMETER RATIO
James Darrel Agar (M.S. Thesis–Wash. Univ., Seattle) 1965 54 p refs
(RL-SA-31)

This investigation was conducted to determine the pressure drop characteristics of cold water flow through two eccentrically positioned orifices in series. The system parameters of flow, orifice spacing, orifice diameter to flow channel diameter ratio, and the degree of orifice eccentricity were included in the investigation. The flow channel was limited to a 1-1/2 inch inside diameter, stainless steel pipe. Author

N66-10777# Oklahoma State Univ., Stillwater.
FRICTION REDUCTION EFFECTS ON TURBULENT FLOWS OF WATER IN ROUGH PIPES BY DILUTE ADDITIVE OF HIGH MOLECULAR WEIGHT POLYMER
E. Rune Lindgren Jun. 1965 26 p refs
(Contract Nonr-2595(05))
(TR-1; AD-621070)

An experimental investigation was made of the reduction of frictional losses in turbulent flows of distilled water through rough tubes by dilute additives of polyethylenoxide of molecular weight 4,000,000. Remarkable reduction of the turbulent energy losses were obtained for 0.002–0.006% concentration of additive in the flow, even to values lower than for smooth turbulent flows. Author (TAB)

N66-10778# Oklahoma State Univ., Stillwater. School of Civil Engineering.
EXPERIMENTAL STUDY ON TURBULENT PIPE FLOWS OF DISTILLED WATER
E. Rune Lindgren Jul. 1965 67 p refs
(Contract Nonr-2595(05))
(TR-2; AD-621071)

Experimental investigation verifying current concepts on fully developed turbulent pipe flow. Previous contradictions and uncertainties on certain details may now be considered as resolved, also showing that Nikuradses 'classical' experiments must be in error. Serving as a preparation to future studies on turbulent flows of distilled water with certain high molecular weight additives it is shown that presently applied technique is recommendable also for such studies. It appears that minute amounts of additive may have a remarkable influence upon certain thermal properties of distilled water. Author (TAB)

N66-10792# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
THE VELOCITY FIELD DOWNSTREAM FROM A TWO-DIMENSIONAL MODEL HILL, PART 2 Final Report
E. T. Plate and C. W. Lin Aug. 1965 63 p
(Grant DA-AMC-36-039-63-G7)
(CER65EJP-CWL41; AD-620058)

In this second part of the report on the wind field downstream from a two dimensional model hill the experimental data are presented in tabular form. For a first interpretation of the large quantity of data, AD-614 067 should be consulted. TAB

N66-10826# Texas Univ., Austin. Defense Research Lab.
EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF SURFACE ROUGHNESS ON COMPRESSIBLE TURBULENT BOUNDARY LAYER SKIN FRICTION AND HEAT TRANSFER
Frank Levi Young May 1965 166 p refs
(Contract NOrd-16498)
(DRL-532; CR-21; AD-621085)

An experimental investigation was carried out to determine the effects of surface roughness on the turbulent boundary layer skin friction and heat transfer rates in air at a Mach number of 4.93. Four flat plate model configurations were tested. Simultaneous measurements of the local skin friction and heat transfer were made. The results of these measurements and of boundary layer pressure surveys are presented. Agreement of the smooth plate results with accepted theories acts to substantiate the results of measurements using the rough-surfaced models. A method is given to determine the equivalent incompressible sandgrain roughness of a surface based on experimental knowledge of the skin friction in compressible flow. In addition, a method to account for heat transfer effects in the calculation of skin friction coefficients for rough plates is suggested. Using the experimental results, the validity of the Reynolds analogy between heat transfer and skin friction is examined. A method to determine the Reynolds number based on the length of the turbulent boundary layer from measurements of the skin friction and momentum thickness for smooth or rough flat plates is also given. Author (TAB)

N66-10835# Cincinnati Univ., Ohio. Research Foundation.
STUDIES ON DISSOCIATING GASDYNAMICS. PART 3: ON THE DISSOCIATED HYPERSONIC LAMINAR BOUNDARY LAYERS
Shu J. Hsia and Ting Y. Li Jul. 1965 84 p refs
(Grant AF-AFOSR-416-64A)
(AE-6503, Pt. 3; AFOSR-65-0849; AD-621485)

The purpose of this report is to review some recent advances and to try to gather some useful information from the available literature on the study of laminar boundary layer problems including effects of chemical reactions. To provide a background for the study, the basic relations governing the dissociated laminar boundary layer is outlined briefly. Various methods in analyses of dissociated boundary layer problems are investigated and compared in the flat plate case. Particular attention is directed to the discussion of the effects resulting from the consideration of strong self-induced pressure field, of reacting external inviscid flow and of the thermodynamic properties of the reacting gas mixture. Such considerations are usually neglected for the purpose of simplifying the problems. Author (TAB)

N66-10920# California Univ., Berkeley. Inst. of Engineering Research.
EXPANSION OF A PARTIALLY-IONIZED GAS THROUGH A SUPERSONIC NOZZLE
L. Talbot, Y. S. Chou, and F. Robben Aug. 1965 52 p refs
(Grant AF-AFOSR-538-65)
(AS-65-14; AD-471389)

A theoretical investigation was made of the non-equilibrium expansion of a partially ionized gas through a supersonic nozzle. Both hydrogen and argon were studied. The ionization and recombination rate parameters used were those calculated by Bates and co-workers, using their collisional-radiative model of the recombination process. These calculations, for hydrogen, include the influence of radiation trapping on the overall rates, and yield as well as the amount of recombination energy which is gained by the third-body electron in the recombination. The energy balance for the electrons and massive particles was studied for both the optically thin (all recombination radiation lost) and optically thick (all radiation absorbed) cases. It was found that the recombination process produces an increase in electron temperature over that of the ion-atom temperature, and that this temperature difference is greater for the optically thick than for the optically thin case. Also, there is more net recombination for the optically thin case. For high initial ionization (62%), recombination affects the gross flow variables measurably, when compared with the "frozen flow" solution. For low initial ionization (1%) the gross flow variables are practically unaltered, and the principal effect of the recombination is to produce an elevated electron temperature. On comparing the hydrogen and argon flow, one finds that the effect of the larger atomic mass of the argon is to diminish the effectiveness of electron-atom energy exchange, resulting in a larger difference between electron and atom temperatures. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N66-10064 Aerojet-General Corp., Azusa, Calif. Engineer Support Div.
EVOLUTION OF REMOTE HANDLING CAPABILITIES AT NRDS
Maxwell J. Neder and C. D. Montgomery *In* AEC Remotely Operated Special Equipment [1964] p 334–339 (See N66-10051 01-15) CFSTI: $4.00

Remote handling equipment and manipulators used in conjunction with the KIWI NRX type reactors and the NERVA system to perform efficient operations such as assembly and disassembly operations, transportation of reactor and materials to the test cell, maintenance, post mortem examination, and recovery from major malfunctions are described. M.R.W.

N66-10072# Joint Publications Research Service, Washington, D. C.
STUDY IN HYDROMETEOROLOGICAL REGIME AND HEAT BALANCE OF LAKE BAYKAL
V. I. Verbolov, V. M. Sokol'nikov, and M. N. Shimarayev 22 Oct. 1965 7 p Transl. into ENGLISH of the Foreword to the book "Gidrometeorologicheskiy Rezhim i Teplovoy Balans Ozera Baykal" Moscow-Leningrad, Zd-Vo Nauka, 1965 p 3–6 (JPRS-32519; TT-65-32998) CFSTI: $1.00

An outline is presented of a Soviet book entitled *Hydrometeorological Regime and Heat Balance of Lake Baykal*. A short history of the book's development and chapter outlines are included. R.N.A.

N66-10149# Defence Research Board, Ottowa (Ontario). Directorate of Scientific Information Services.
STUDY OF THE EARTH'S CRUST BY SEISMIC METHODS
I. P. Kosminiskaya Jun. 1965 11 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 2, 1965 p 51–57 (T-426-R; AD-620208)

Present concepts of the earth terrestrial crust are discussed and seismic methods for studying various geophysical fields are reviewed. Areas of the crust which have been studied, the variation of velocity in the crust, a cross section of the crust and the character of the gravity field of the earth for different tectonic zones, and a cross section of the crust and character of the gravity field in the zone of transition from continent to ocean are presented. E.E.B.

N66-10171# Bureau of Reclamation, Denver, Colo. Structural and Architectural Branch.
GRIFFITH'S THEORY OF RUPTURE
E. D. Morgan and J. F. Class Jun. 1965 41 p refs (SA-3; AD-466571)

Griffith's theory of rupture correctly portrays the mechanism of failure for brittle materials. Brittle fracture is due to high tensile stresses generated at the tips of the microscopic cracks which exist in all brittle materials. This high tensile stress exists near the tip of an elliptical crack regardless of the sign of the external stresses. Considerably more experimental research must be performed before the Griffith theory of rupture can be applied safely to engineering problems connected with rock mechanics. McClintock and Walsh modified Griffith's theory to take into account frictional forces which are developed when the crack is compressed. The modified Griffith theory is identical with the Coulomb law in the region of compression. After reviewing both Griffith's theory and the modified theories, it is concluded that Mohr's criteria to predict failure conditions in rock are the most applicable at the present time. Author

N66-10353# California Univ., Los Angeles.
THEORETICAL AND EXPERIMENTAL STUDIES OF SEISMIC WAVES IN GEOMETRICALLY AND PHYSICALLY HETEROGENEOUS REGIONS OF THE EARTH Final Report
Leon Knopoff Aug. 1965 8 p refs
(Grant AF-AFOSR-710-64)
(AD-619739)

Work on seismographic observations of the crustal structure of the Alps was completed by application of a technique that reduced the debilitating influence of beats upon surface wave recordings. A good correlation of phase velocity with Bouguer anomaly was found, and an alpine root extending to M = 60 km at the crest of the Alps was established. Various annotated studies on theoretical and applied seismology are also presented. G.G.

N66-10354# Tohoku Univ., Sendai (Japan). Faculty of Science.
GEOPHYSICS, VOLUME 16, NO. 2
Giichi Yamamoto, ed. Mar. 1965 74 p refs *Its* Sci. Rept., Ser. No. 5 CFSTI: HC $3.00/MF $0.75

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N66-10355 Tohoku Univ., Sendai (Japan). Geophysical Inst.
THE EFFECT ON THE GEOMAGNETIC MICROPULSATION OF THE SOLAR ECLIPSE OF 20 JULY 1963
Yoshio Kato *In its* Geophys., Vol. 16, No. 2 Mar. 1965 p 49–62 refs Submitted for publication Prepared in cooperation with Alaska Univ. (See N66-10354 01-13) CFSTI: HC $3.00/MF $0.75
(Contract AF 19(628)-1695)

The effect on the geomagnetic micropulsation of the total eclipse of 20 July 1963 was observed very distinctly at Northway, Alaska in the auroral zone. The continuous geomagnetic micropulsations (pc 3) were observed almost every day at Northway. The direction of the principal axis of the vector diagram of these micropulsations changed very distinctly at the time of solar eclipse. This is due to the decrease of the electrical conductivity in the ionosphere at the time of solar eclipse and a brief estimation was made theoretically. The above observation was carried out under the cooperation of the Geophysical Institute, University of Alaska and the Ministry of Education of the Japanese Government to whom thanks are due. Author

N66-10356 Tohoku Univ., Sendai (Japan). Geophysical Inst.
THE EFFECT ON THE GEOMAGNETIC FIELD OF THE TOTAL SOLAR ECLIPSE OF 5 FEBRUARY 1962 AND THE CORPUSCULAR ECLIPSE OF THE SOLAR CORPUSCULAR BEAM ON THE SURFACE OF THE BOUNDARY OF GEOMAGNETIC CAVITY
Yoshio Kato *In its* Geophys., Vol. 16, No. 2 Mar. 1965 p 63–77 refs (See N66-10354 01-13) CFSTI: HC $3.00/MF $0.75

In order to observe the effect on the geomagnetic field of the solar eclipse of Febraury 5, 1962 at Lae, New Guinea, the author observed the geomagnetic field by the Askania type field magnetometer and also observed the geomagnetic pulsation by the induction magnetometer. While the magnetic storm with sudden commencement occurred at 19^h30^m, February 4 (150° E.M.T.) and this magnetic storm still continued at the time of the solar eclipse of February 5. Therefore, it is too complicated to study the effect on the geomagnetic daily variation of this solar eclipse. On the other hand we could observe the geomagnetic micropulsation accompanying this magnetic storm, and it is very interesting that the effect on this magnetic micropulsation of the solar eclipse was observed, that is the direction of the principal axis of the vector diagrams of these geomagnetic micropulsations changed during the solar eclipse. This character is expected if the electrical conductivity in the ionosphere decreased at the time of eclipse as observed by the Radio Research Laboratory at same place. On the other hand the zone of the totality of the corpuscular eclipse of the solar corpuscular beam of this storm on the surface of the magnetopause was calculated. It is very interesting that the effect of the corpuscular eclipse on the surface of the boundary of the geomagnetic cavity, whose radius is six earth radii, was observed too, and this effect is expected as the hydromagnetic disturbance excited on the boundary of the magnetic cavity due to the moon's shadow of the solar wind or the lunar hydrodynamic wake staying few hours on the same place on the boundary of the magnetopause. Author

N66-10357 Tohoku Univ., Sendai (Japan). Geophysical Inst.
METHODS OF ESTIMATING THE EDDY DIFFUSIVITY FROM THE DATA OF VELOCITY FLUCTUATION
Atsushi Shimanuki *In its* Geophys., Vol. 16, No. 2 Mar. 1965 p 78–89 refs (See N66-10354 01-13) CFSTI: HC $3.00/MF $0.75

Dependence of eddy diffusivity on the time-distribution and spatial dimension of cluster is clarified by the statistical theory of diffusion. The theory of diffusion has been developed by use of the following assumptions: Local time-space correlation of velocity is formulated, as a product of the Lagrangian correlation coefficient and local energy. The local energy in time-space is expressed by an interpolation formula. Diffusion chart to be used in estimating diffusivity from the time-space dimensions of cluster and data of wind fluctuation is constructed. The relation between diffusivity and scale of phenomenon is discussed. Author

N66-10358 Tohoku Univ., Sendai (Japan). Geophysical Inst.
REFRACTION OF EXPLOSIVE SOUND WAVES FROM A LINE SOURCE IN AIR INTO WATER
Kohei Nakamura and Hiroshi Ishii *In its* Geophys., Vol. 16, no. 2 Mar. 1965 p 90–121 refs (See N66-10354 01-13) CFSTI: HC $3.00/MF $0.75

An explosive sound wave is emitted from a line source in air which is separated from underlying water by an infinite plane surface. The problem of refraction of the wave into water is solved both by an exact method of integration developed by GARVIN and by an approximate evaluation by the method of steepest descents of the solution of the wave equations. Especially, natures of the motion of a water particle near the surface and very far from the source are made clear. Author

N66-10364# Joint Publications Research Service, Washington, D. C.
ON THE ESTIMATION OF THE DEPTH OF THE LOWER BORDER AND MAGNETISM OF TWO-DIMENSIONAL BODIES OF RECTANGULAR PROFILE BY MEANS OF Z ANOMALY (Vzz)
A. A. Lyubimov 5 Oct. 1965 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Geol. i Razvedka (Moscow), no. 7, Jul. 1965 p 123–128
(JPRS-32267; TT-65-32757) CFSTI: $1.00

Various methods are discussed that determine the horizontal half-thickness and the depth of the upper edge of a vertically magnetized layer stretching to infinity. The value of the magnetic field intensity was expressed by formula:

$$Z = 2 \times j \left[\operatorname{arc\,tg} \frac{2bh}{x^2 - b^2 + h^2} - \operatorname{arc\,tg} \frac{2bH}{x^2 - b^2 + H^2}\right],$$

where x is the horizontal coordinate of the observation point, counted from the origin of the coordinate, taken over the center of the layer; b is the horizontal half-thickness of the layer; h is the depth of the upper edge of the layer; H is the depth of the lower border of the layer; and j is the magnetization intensity. G.G.

N66-10430*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEUTRAL HYDROGEN IN THE EARTH'S ATMOSPHERE AOBVE 120 KM
Mordehai Liwshitz (NAS-NRC) Oct. 1965 43 p refs
(NASA-TM-X-55298; X-640-65-428) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Results are presented of a study of neutral hydrogen distribution in the upper atmosphere based on a Monte Carlo calculation of the quasi-stationary neutral hydrogen distribution in the transition region between the collision dominated lower thermosphere and the collisionless exosphere. New calculations were made of the hydrogen concentration as a function of

altitude, and the hydrogen content between 120 km and various altitudes for various temperatures of the thermopause between 1000° and 2500° K. The latter reveal that the total hydrogen content of the atmosphere is increased by a factor of 1.1 at 2500° K to 2.0 at 1000° K. This points to a greater swing in hydrogen content between temperature extremes than that conventionally deduced. Both a higher hydrogen content and a greater amplitude of variation with temperature appear closer to explaining the experimental evidence. They also emphasize the need for a calculation considering hydrogen convection between regions of varying concentration and the effect of the diurnal temperature variation which is too fast to permit the establishment of stationary conditions throughout the whole atmosphere. R.N.A.

N66-10432# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR AUGUST 1964 FROM WOOMERA, SOUTH AUSTRALIA
Feb. 1965 28 p
(WRE-CPD-1964/8(W)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for August 1964. Author

N66-10433# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
AIR-BLAST YIELD SCALING IN REFRACTING ATMOSPHERES
Jack W. Reed Jul. 1965 13 p refs Supported by AEC
(SC-RR-65-369)

Different atmospheric blast propagations result from various refractive wave divergence rates and give different overpressure-distance decay rates. This results in yield-scaling factors which depend on the decay rate for a given weather situation. A derivation has been made which allows yield-scaling exponent determination from an observation of blast overpressure from a known-yield check shot. Conversely, from check-shot microbarograph recordings at vulnerable cities, an estimate can be made of yield limitations necessary to avoid window damages under the same weather conditions. Author

N66-10435# New Mexico Univ., Albuquerque. Dept. of Physics and Astronomy.
REPORT ON OBSERVING CONDITIONS AT CAPILLA PEAK OBSERVATORY
David King and A. G. Davis Philip 25 Oct. 1965 16 p refs

Various observing conditions for the Capilla Peak Observatory in Albuquerque, New Mexico are described and include rainfall, sky cover, temperature variations, wind, and seeing quality. The discussion is supplemented with graphical data. R.N.A.

N66-10444# Library of Congress, Washington, D. C. Aerospace Technology Div.
OPTICS OF THE EARTH'S ATMOSPHERE AND TURBID MEDIA Surveys of Communist World Scientific and Technical Literature
Yuri Ksander 12 Oct. 1965 82 p refs Compilation of Abstracts
(ATD-P-64-66)

An annotated bibliography is presented on optical radiation transfer models and optical properties of the atmosphere. References are included on transfer equations and multiple scattering; scattering by spherical particles in suspensions; scattering in the presence of turbidity and absorption; scattering by fogs and hazes; scattering by aerosols, twilight phenomena, sky brightness, and air glow; spectral polarization by the atmosphere; size, concentration, and vertical distribution of aerosols in the atmosphere; composition of aerosols; and a conference on actinometry. R.N.A.

N66-10476# Joint Publications Research Service, Washington, D. C.
USE OF THE URAL-2 ELECTRONIC COMPUTER FOR COMPUTING TIDAL PARAMETERS BY HANSEN'S METHOD
S. I. Stepanov 12 Oct. 1965 17 p refs Transl. into ENGLISH from Tr. Arkticheskogo i Antarkt. Nauchno-Issled. Inst. (Leningrad), v. 271, no. 1, 1964 p 100–114
(JPRS-32358; TT-65-32848) CFSTI: $1.00

The application of the computer for the computation of the fluctuations in tidal level and of flood and ebb tide flows is considered successful and the accuracy of the calculation is adequate for practical demands. To program the problems of computing tidal phenomena for any region, the region must be inscribed in a rectangle or square. This method enables the problem to be solved without continually resorting to a new program to compute parameters for water basins of any configuration. Practical tidal parameter computation demonstrates that it is best to prescribe an iteration accuracy of no more than 0.1 which is considered adequate for practical applications. Also, accuracy in computing tidal parameters is determined by the reliability of the boundary conditions. The boundary conditions and initial data must therefore be critically examined. E.E.B.

N66-10485# Joint Publications Research Service, Washington, D. C.
USE OF ARTIFICAL EARTH SATELLITES FOR GEODETIC PURPOSES
A. P. Polezhayev 13 Oct. 1965 5 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 8, Aug. 1965 p 67–69
(JPRS-32389; TT-65-32879) CFSTI: $1.00

Various aspects of the use of artificial earth satellites in geodesy which were discussed at the International Geodetics Association symposium in Athens are summarized. Included are the following: (1) the refining of the coordinates of 180 000 stars of the Northern Hemisphere up to the 9th magnitude; (2) high precision camera for tracking satellites; (3) laser–artificial satellite combination for geodetic purposes; (4) use of artificial satellite orbits for determining the form of the earth, the parameters of its gravitational field, and the construction of triangulation networks; (5) geometric methods for cosmic triangulation; (6) geodetic parameters from Doppler observations of earth satellites; (7) space triangulation equations from data obtained by earth satellites; and (8) selenodesy. E.E.B.

N66-10489# Joint Publications Research Service, Washington, D. C.
USE OF TOWED THERMISTOR CHAINS FOR INVESTIGATING THE THERMAL STRUCTURE OF THE SEA
E. A. Lyamin, M. F. Naumenko, V. T. Paka, K. I. Chigrakov, and M. A. Shmatko 14 Oct. 1965 7 p refs Transl. into ENGLISH from Okeanologiya (Moscow), v. 5, no. 3, 1965 p 553–556
(JPRS-32391; TT-65-32881) CFSTI: $1.00

The results of measurements with a chain of thermistor transducers mounted on an insulated rubber multi-conductor cable are discussed. Vertical distribution of temperature in water at different times of day, changes in temperature profiles, and curves for the mean value of temperature and the mean square deviation of temperature are given. The

data indicated the vertical nature of motion in the water and that the recorded fluctuations reflect the specific nature of the temperature field structure. The method permits the study of the temperature field of the sea both from an average and pulse point of view and to estimate the vertical shifts in the water layers appearing in the temperature structure of the sea. E.E.B.

N66-10491# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF MEASURING THE VERTICAL GRADIENT OF GRAVITATIONAL FORCE
V. N. Stadnichenko 12 Aug. 1965 5 p Transl. into ENGLISH from Soviet Patent No. 162671 (Appl. No. 8264741 26-10, 22 Mar. 1963) 2 p
(FTD-TT-65-635/1+4; AD-620776)

A method of measurement is proposed of the vertical gradient of the force of gravity with the aid of a system of weights arranged at different heights, which has the distinguishing feature that for the purpose of increasing the precision of the measurements, two weights the upper one of which has positive buoyancy and the lower one negative, rigidly joined one with the other, are placed in a liquid and the change in the vertical gradient is measured by the change in the buoyancy of the system. TAB

N66-10526# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF MODERN SEISMOLOGY AND A SINGLE SYSTEM OF SEISMIC OBSERVATIONS IN THE USSR
Ye. F. Saverenskiy 15 Oct. 1965 6 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 7, Jul. 1965 p 39–41
(JPRS-32430; TT-65-32919) CFSTI: $1.00

The problem of earthquake prognosis through continuous observations by a network of constantly operating seismic stations is discussed. These observations of the earth's mantle to depths of several hundred kilometers are based on the speed of reflecting relay waves that circle the earth. The waves are dispersed by the stratified portion of the earth and increase when the phase velocity increases. The nature of their dependent relationship is determined by the structure of the earth, and by the distribution of the transverse seismic waves with depth and speed of propagation. G.G.

N66-10562# Naval Oceanographic Office, Washington, D. C. Forecasting Branch.
THE ARCTIC ICE OBSERVING AND FORECASTING PROGRAM, 1962 Eleventh Annual Report
Apr. 1965 170 p
(SP-70(62); AD-616261) Available from Naval Oceanog. Office: $2.00

The eleventh annual report summarizes the ice program of the U.S. Naval Oceanographic Office. Although the program principally supported Military Sea Transportation Service supply operations in the eastern Arctic, many allied projects were also included. The ice forecasting and observing program in the North American Arctic has not only provided direct support to sealift operations but has also made possible the accumulation of historical data necessary for effective planning and successful execution of Arctic operations. Author (TAB)

N66-10660# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR SEPTEMBER 1964 FROM SALISBURY, SOUTH AUSTRALIA
Oct. 1964 26 p
(WRE-CPD-1964/9(S)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for September 1964. Author

N66-10661# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR SEPTEMBER 1964 FROM WOOMERA, SOUTH AUSTRALIA
Feb. 1965 28 p
(WRE-CPD-1964/9(W)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for September 1964. Author

N66-10686*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DETERMINATION OF THE ABSOLUTE SPACE DIRECTIONS BETWEEN BAKER-NUNN CAMERA STATIONS
L. Aardoom, A. Girnius, and G. Veis 6 Sapt. 1965 32 p refs (Grant NsG-87-60)
(NASA-CR-67795; SAO Special Rept.-186) CFSTI: HC $2.00/MF $0.50 CSCL 08E

From quasi-simultaneously observed satellite transits, synthetic simultaneous observations are computed. Some 615 pairs of such observations are used to determine fixed-earth directions for 14 lines connecting adjacent Baker–Nunn camera stations. The method is described, and the results are given. They indicate that an accuracy in the directions between 2 and 5×10^{-6} (standard deviation) is feasible. With 10 of those directions, a three-dimensional triangulation is performed with six of the stations. Author

N66-10722# Oak Ridge National Lab., Tenn.
CONTRIBUTION TO THE REVERSAL OF PLEOCHROIC HALOS
Maximilian Weber [1965] 7 p Transl. into ENGLISH from Centr. Mineral., Geol. (Germany), 1923 p 388–392
(ORNL-TR-698)

A thin section of cordierite gneiss is observed for reversal of pleochroic halos. A biotite is adjoined to a larger cordierite crystal so that biotite and α-direction in the cordierite are almost simultaneously extinguished. At the boundary between the two is a fairly large rounded zircon which projects almost uniformly into the two minerals. The zircon nucleus, which is charged with radioactive substances, is common to two different sensitive materials but produces different effects in each. A few halos are observed in the cordierite crystal, and a large halo is common to both biotite and cordierite. According to Joly, reversion of pleochroic halos sometimes occurs in such a manner that the inner region is light and the outer region dark, resulting in only an isolated outer ring; and the halo reversal can be attributed to uranium abundance rather than age of the rock. It is speculated, however, that with a minimum of radioactive substance the reaction of host mineral plays a role in reversal; and in some cases a very high relative age can be assumed. M.W.R.

N66-10783# Naval Ordnance Lab., Corona, Calif. Research Dept.
STATISTICAL EVALUATION OF SFERICS DISTRIBUTION
James N. Martin and Verne E. Hildebrand 16 Aug. 1965 95 p refs
(NOLC-628; AD-620459)

Several thousand sferics direction-of-arrival photographs have been analyzed and averaged to give monthly average sferics activity as a function of direction-of-arrival at the NOLC field site. The information on thunderstorm frequencies

throughout the world, as given in the United States Air Force Handbook of Geophysics, was analyzed to give rough predictions of the expected sferics activity. All results are given in the form of bar graphs that show predicted and measured values of the relative sferics activity for each 6 deg azimuthal sector. The predicted and measured values are similar in many respects, but significant differences do occur. Author (TAB)

N66-10794# Ohio State Univ. Research Foundation, Columbus. Inst. of Geodesy, Photogrammetry and Cartography.
GREEN'S FUNCTIONS IN PHYSICAL GEODESY AND THE COMPUTATION OF THE EXTERNAL GRAVITY FIELD AND THE GEODETIC BOUNDARY VALUE PROBLEM Scientific Report No. 15
Helmut Moritz Jun. 1965 72 p refs *Its* Rept.-49
(Contract AF 19(628)-2771)
(AFCRL-65-522; AD-620035)

Of the two main approaches to boundary value problems—the use of Green's functions and of integral equations—the latter approach has been chosen almost exclusively for the geodetic boundary value problem. The present report shows how Green's functions may be used for re-deriving known formulas and also for obtaining new results. Formulas for the third boundary value problem for the sphere are developed and then specialized to Stokes' problem. As a limiting case, the boundary value problem for the plane is briefly considered. Then a formula for the variation of Green's function with the boundary surface is developed and applied to the problem of Molodensky. The main purpose of the present paper is to give formulas and, as an appendix, some estimates for the effect of topographic height on these computations. In addition, the paper presents connections between the determination of the external gravity field from surface data, which is related to the conventional boundary value problems of potential theory, and the determination of the earth's physical surface itself, which is specifically geodetic boundary value problem. TAB

N66-10833# Barkley and Dexter Labs., Inc., Fitchburg, Mass.
A STUDY OF GEODETIC TECHNIQUES Final Report, 1962–Dec. 1963
Raymond B. Wilson, Jr. Dec. 1963 86 p refs
(Contract AF 19(604)-8852)
(AFCRL-65-102; AD-621046)

Studies of the geodetic potential of measuring systems employing light, microwaves, very low frequency and extra low frequency radio waves are given with emphasis on the type of measurement each system is best suited for. A summary of the accuracies possible with a sample system gives an idea of the design considerations necessary in that part of the spectrum. A section on transmitting media outlines the fundamentals of atmospherics encountered in each part of the spectrum, and suggestions for elimination of errors due to atmospherics are given. Sample techniques presently employed in geodetic systems are given to illustrate the use of these techniques and to illustrate the source of errors in each technique. Reports of mathematical investigations and field tests undertaken during this contract and the subsequent results of these projects are given. These projects are evaluation reports of existing or experimental equipment and their use may apply to more than one section of the frequency spectrum and are presented under a separate section. Author (TAB)

N66-10877*# Stanford Research Inst., Menlo Park, Calif.
TIROS RADIATION MEASUREMENTS AND VARIATIONS IN ATMOSPHERIC HEATING Quarterly Progress Report No. 2, 8 May–15 Aug. 1965
Paul A. Davis and Robert L. Mancuso Aug. 1965 35 p refs
(Contract NAS5-9540)
(NASA-CR-67701) CFSTI: HC $2.00/MF $0.50 CSCL 04A

One of the difficulties in the quantitative application of satellite radiation data is the sampling bias that results from the anisotropic nature of the emerging radiation. Estimates of the bias were determined independently from instrumental degradation by generating scan statistics for a computer-simulated TIROS satellite and from an available theoretical distribution of reflected radiation from a turbid atmosphere. The bias associated with restricted satellite measurements was determined for the sunlit hemisphere during the six months between minimum and maximum solar declination. Within the limits of the investigation, the most extreme bias led to an albedo that was only 51 percent of the true albedo. Equations and sample distributions are reviewed. With the aid of recently-published ozoneonde data, computations were made of the effective temperature for downward views of the atmosphere, with and without ozone, for the spectral region of Channel 2 of TIROS. A revised computational infrared model was applied to data for two viewing angles at a few widely-separated stations in summer and winter. The limited results suggested that patterns of Channel 2 temperature that are computed without an account of ozone are realistic, although gradients tend to be exaggerated slightly. Author

N66-10914# Stanford Research Inst., Menlo Park, Calif.
STUDIES OF RF SCATTERING PROCESSES FROM IONIZED UPPER ATMOSPHERIC PERTURBATIONS Final Report, Jul. 1964–Aug. 1965
D. R. Allison and W. G. Chesnut Jul. 1965 161 p refs
(Contract AF 19(628)-3296; ARPA Order 42-61)
(AFCRL-65-517; AD-470339)

A special study is made of negatively shifted Doppler radar signals observed following high-altitude, high-explosive detonations. Suggested causes of these negatively shifted signals are presented. The data obtained during 3-electron affinity chemical releases in the F-region are given special study. Effects on other electron affinity release seem far more complex and do not seem to be explained well by a simple model. Quantitative cross-section estimates are made. A study is made of the criteria of importance to the use of continuum hydrodynamics at high altitudes. A decision criterion is suggested. A theory is developed which predicts altitude limits on the generation of air shock waves. The theory also predicts quite well equilibrium-high-explosive radii observed in the altitude region of 90 km to 120 km and in other tests which have been applied. The theory also seems to predict fairly well effects observed on events Fanny and Gilda. Author (TAB)

N66-10919# California Inst. of Tech., Pasadena. Seismological Lab.
INVESTIGATION OF THE ELECTROMAGNETIC SPECTRUM IN THE FREQUENCY RANGE 0.025 TO 5 CYCLES/SEC Final Report, 29 Jun. 1964–1 Sep. 1965
Robert L. Kovach 1 Sep. 1965 25 p refs
(Contract DA-31-124-ARO(D)-18)
(AROD-1704-3; AD-471539)

Geomagnetic micropulsations in the period range of 0.3 to 120 seconds have been recorded on flux-rate variographs at many widespread locations. The collection of data obtained from July 1955 to September 1965, represents the longest continuous record of geomagnetic variations in the period range available in this country. Selected natural and artificial magnetic disturbances recorded at several stations around the globe were analyzed and compared with magnetohydrodynamic theory. (TAB)

N66-10931# Adelaide Univ., (Australia). Dept. of Physics.
MOLECULAR OXYGEN DENSITY AND ULTRA-VIOLET ABSORPTION IN THE SOUTHERN ATMOSPHERE
J. H. Carver, P. Mitchell, E. L. Murray, and Bryan Rofe (Weapons Res. Estab., Salisbury, Australia) [1965] 8 p refs Sponsored by Australian Dept. of Supply
CFSTI: HC $1.00/MF $0.50

Molecular oxygen number densities have been determined at 1 km intervals in the range 72–90 km by rocket measurements from Woomera of the atmospheric absorption of solar Lyman-α radiation. Below 80 km these Southern Hemisphere date are less than the 1962 U.S. Standard Atmosphere values but they exceed the Standard Atmosphere values at higher altitudes. The temperatures derived from the measured densities are significantly different from those of the Standard Atmosphere. Author

N66-10934# Library of Congress, Washington, D. C. Aerospace Technology Div.
ATTENUATION OF VISIBLE AND INFRARED RADIATION BY ARTIFICIAL WATER FOGS [OSLABLENIYE VIDIMOY I INFRAKRASNOY RADIATSII VODNYMI ISKUSTVENNYMI TUMANAMI]
V. Ye. Zuyev, B. P. Koshelev, S. D. Tvorogov, and S. S. Khmelevetsov 20 Oct. 1965 13 p refs Transl. into ENGLISH from Fiz. Atmosfery i Okeana (USSR), v. 1, no. 5, 1965 p 509–516)
(ATD-T-65-87)

The results of theoretical and experimental studies of the optical and microphysical properties of artificial fogs are discussed. Quantitative data on the attenuation of infrared radiation in fogs obtained by taking into account polydispersion and absorption in water droplets are compared with results of experimental determinations of the spectral transmittance of fogs. Author

N66-10958*# Geophysics Corp. of America, Bedford, Mass.
OBSERVED CHARACTERISTICS OF IONOSPHERIC WINDS
J. F. Bedinger and H. B. Knaflich Aug. 1965 35 p refs (Contract NASw-1083)
(NASA-CR-67913; GCA-TR-65-26-N) CFSTI: HC $2.00/MF $0.50 CSCL 04A

The general characteristics of ionospheric winds during twilight have been determined from observations of the motion and growth of sunlit trails of alkali vapor. Typical large shears and small features are described. Specific wind profiles are compared with nearly simultaneous measurements of electron concentration from rocket-borne probes. Generally, the narrow regions of enhanced electron concentration measured by the probes do not occur in the low velocity region of an E-W shear. However, the ionization peaks appear to be associated with certain other features of the wind profile. Author

N66-10974# Joint Publications Research Service, Washington, D. C.
SEISMOLOGICAL INVESTIGATIONS OF THE INSTITUTE OF EARTH PHYSICS
V. M. Arkhangel'skaya 13 Oct. 1965 4 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 8, Aug. 1965 p 91–92
(JPRS-32387; TT-65-32877) CFSTI: $1.00

The study of the physics of earthquakes is based on an investigation of the earth's structure and properties using seismic, gravitational, geological, and various other methods. Also, it is based on the theory of the strength and disruption of an actual solid body, on the physico-chemical investigations of the properties of rocks and of other materials under various conditions, especially at raised temperatures and pressures inherent to the earth's interior where the earthquake foci developed. It was noted that the practical results gained promoted the establishment of quantitative methods of seismic regioning and the development of ways for predicting earthquakes. It was concluded that seismology plays a basic role in the study of the earth's resources, and in the conduct of a program on the upper mantle and its effect on the development of the earth's crust. R.W.H.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-10069# Atomic Energy of Canada Ltd., Chalk River, Ontario.
A PORTABLE LEAK DETECTOR FOR HEAVY WATER
R. B. Shields Apr. 1965 27 p refs
(AECL-2278) CFSTI: HC $2.00/MF $0.50

A thermal conductivity cell measures the moisture picked up by dry air passed through a shroud clamped over the fitting under test. Using continuous sampling, the nominal leak detection range for heavy water is 1 mg/h to 650 mg/h. Intermittent sampling increases the sensitivity up to 20 times with reduced accuracy. The leak detector can also be used without modification on systems containing many other volatile liquids and gases. Author

N66-10079 Hanford Atomic Products Operation, Richland, Wash.
A PROCEDURE FOR COLOR MICROPHOTOGRAPHY
W. J. Gruber *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 26–29 (See N66-10076 01-15) CFSTI: $5.00

This paper describes the criteria and a procedure for successful color photography with a metallograph. Some of the fundamentals of color photography, which are considerations affecting the method selected, are discussed. Author

N66-10179 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ELECTROMAGNETIC FLOWMETER WITH AN INHOMOGENEOUS MAGNETIC FIELD OF THE PICKUP
I. G. Fiks *In its* Automation 2 Apr. 1965 p 24–39 refs (See N66-10176 01-10)

To determine whether a flowmeter with an inhomogeneous magnetic field would have the required accuracy, the magnetic field produced by a pickup winding with circular channels was analyzed. Equations are given, and results show that the magnetic flux of the zero component is distributed uniformly at the cross section of the pickup; fluxes due to other components are concentrated near the pickup center; and the higher the order of the component, the narrower the ring containing the main portion of the magnetic flux. The magnitude of the electric field potential, in the fluid crossing the magnetic field of flowmeter pickup, was also investigated.

In determining the magnetic system parameters, the pickup design was reduced to geometrical dimensions and parameters of the winding. Basic design data include the inner pickup diameter, the pickup sensitivity, permissible error, winding supply voltage, frequency, space factor, and current density of the windings. With the described procedure, the winding cross section is independent of the pickup diameter, with coil weight determined by average length of the turns; this is considered its main advantage over other flowmeter systems. M.G.J.

N66-10206# Princeton Univ., N. J. Plasma Physics Lab.
A FERROMAGNETIC RESONANCE MAGNETOMETER
W. P. Ernst and A. H. Skislak Sep. 1965 14 p refs
(Contract AT(30-1)-1238)
(MATT-362)

Considered is a microwave system which was developed to satisfy the following requirements: (1) measuring the magnitude of the confining field to 1 part in 10^4; and (2) providing a timing signal when the magnetic field reached a predetermined magnitude. Magnetic fields of the order of 12.5 kilogauss were used in the experiment and a time scale of milliseconds. It was noted that the ferromagnetic magnetometer system was capable of measuring transient magnetic values with the accuracy of 1 part in 10^4. The use of the YIG (yttrium iron garnet) material also enables the performance of point measurements where large gradients are present. Also mentioned were the frequency measuring system, the YIG waveguide mount, and the remote control frequency. R.W.H.

N66-10329*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CALIBRATION OF CONICAL PRESSURE PROBES FOR DETERMINATION OF LOCAL FLOW CONDITIONS AT MACH NUMBERS FROM 3 TO 6
John D. Norris Washington, NASA, Nov. 1965 68 p refs
(NASA-TN-D-3076) CFSTI: HC $3.00/MF $0.75 CSCL 14B

A wind-tunnel investigation was conducted to study the characteristics of six cones, which varied in diameter and cone angle, for use as pressure probes in the determination of Mach number, total pressure, and flow angles. The cones had four equally spaced static-pressure orifices on the surface and a total-pressure orifice at the apex. Pressure measurements were taken at Mach numbers of 3.0, 4.5, and 6.0 and angles of pitch up to about 20°. The tests were conducted at a Reynolds number per foot (per 30.5 cm) of approximately 0.85×10^6. The results indicate that Mach number can be determined within approximately ±3 percent and flow angles within about ±0.5°. The possible error in determining total pressure increases with increasing Mach number. Total pressure can be determined within approximately ±5 percent at a Mach number of 3.0 and ±13 percent at a Mach number of 6.0. These quoted accuracies are for the instrumentation and techniques employed in this investigation and are not necessarily the limiting capability of the method itself. In general, an iterative procedure is usually required in order to obtain the best accuracy with this method. Author

N66-10336*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATIONS OF A VOLUME-RATIO CALIBRATION SYSTEM FOR VACUUM GAGES FROM 10^{-6} TO 10^{-3} TORR
Raymond Holanda Washington, NASA, Nov. 1965 19 p refs
(NASA-TN-D-3100) CFSTI: HC $1.00/MF $0.50 CSCL 14B

An evaluation was made of a volume-ratio calibration system in the range from 10^{-6} to 10^{-3} torr. An error analysis showed that the pressures could be produced with a limit of error ranging from about 6 percent at 10^{-6} torr to 1 percent at 10^{-3} torr. An analysis was also made of the effects of ionization gage pumping, outgassing, ultimate pressure, and adsorption. Finally, commercial ionization gages were calibrated in the system. Large differences in calibration factors were observed between different gages along with various nonlinearity effects; however, the reproducibility of a typical ionization gage calibration curve was found to be about 3 percent. Author

N66-10368# British Telecommunications Research, Ltd., Taplow (England).
MEASURING TECHNIQUES FOR FLUID DEVICES, PAPER D2
D. J. Craft [1965] 16 p refs Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

The paper surveys some of the existing instrumentation techniques and discusses their limitations especially with regard to dynamic pressure and flow measurements on small integrated high speed systems. A technique for incorporating high speed pressure transducing equipment directly into fluid channels in integrated circuit assemblies is described. Hot wire anemometry is considered in some detail as a measurement technique and an iterative procedure for steady state analysis of nonlinear anemometer control circuitry is presented. Hot wire probe linearization is also considered. Author

N66-10402* Westinghouse Electric Corp., Baltimore, Md.
SELF-CALIBRATING AND SELF-CHECKING INSTRUMENTATION FOR MEASUREMENT OF THE SHORT-TERM FREQUENCY STABILITY OF MICROWAVE SOURCES
C. H. Grauling, Jr. and D. J. Healey III *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 11 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50
(Contract NOw-63-0280-di)

The short-term frequency stability of a phase-stable source, or stalo, is best expressed in terms of sideband levels. This paper discusses the apparatus that is employed to measure a spectral density of −115 db/cps at 1000 cps from the carrier frequency at X-band. A passive reference is employed, although use of an active reference source is considered. Two types of passive measuring apparatus are discussed in detail: the RRE discriminator, and a test set. The latter provides a number of significant features that are not obtained with the RRE discriminator, for example, the capability of direct calibration, direct determination of the limiting sensitivity, and the measurement of intentional modulation appearing on the source. Author

N66-10424*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CALIBRATION OF A COMPACT SURVEY PROBE FOR PITOT PRESSURE, MACH NUMBER, AND FLOW ANGULARITY MEASUREMENTS
W. L. Fox and R. B. Blaylock 15 Mar. 1965 15 p refs
(Contract NAS7-100)
(NASA-CR-67715; JPL-TM-33-179) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A pressure survey probe, designed to evaluate the flow field between a body in hypersonic flow and its shock wave, has been fabricated and experimentally calibrated. The probe geometry consisted of a 60-deg total angle cone with a maximum diameter of 0.234 in. A concentric pitot pressure port

and four symmetrical cone static pressure ports were calibrated in terms of pitot pressure, Mach number, and flow angularity in the vertical plane. The calibration included Mach numbers of 1.33 to 3.26, Reynolds numbers of 3×10^4 to 3×10^5 per inch, and flow angles to 10 deg. This probe and calibration departed from the conventional wind tunnel cone static probe in two ways: the cone static pressure ports were quite close to the cone nose which was blunted by the pitot pressure port, and the calibration extended to both sides of the theoretical sharp-cone bow-shock detachment Mach number of 1.48. In view of its compact size and these compromises, the calibration data indicate that this relatively rugged probe will yield unambiguous results of moderate accuracy. Author

N66-10459# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
DEVELOPMENT OF SCINTILLATION AND IONIZATION METHODS OF RADIOMETRY AND DOSIMETRY
M. I. Arsaev et al [1964] 9 p refs In RUSSIAN *Its* Rept.-73
(NP-15259) CFSTI: HC $1.00/MF $0.50

Because of the variety of available scintillators, scintillation methods have widespread application. By simply changing the scintillator, the USD-1 type universal counter may be used for measuring the α activity of materials in the presence of a β and γ background, measuring the β activity of liquids, solids, and powdered materials in the presence of an α and γ background within a β energy range from 0.2 to 1.5 Mev, performing γ spectrometric studies, measuring low γ activities, and determining thermal and fast neutron fluxes up to 200 μR/sec. Work with labeled atoms requires the measurement of the absolute activity of low-energy β emitters; such measurements may be conveniently carried out with liquid scintillation counters, immersing the β emitter into the liquid, thereby achieving 4π geometry. The problems presented by this type of counters include the absence of an air-equivalent scintillator with a sufficiently high light yield and the difficulty of determining the bremsstrahlung. For fast neutron dosimetry ZnS(Ag) and H-containing organic materials are employed. Work is in progress for gaseous scintillation counters for the construction of high-sensitivity neutron detectors, to operate in a high γ background. NSA

N66-10589# Sexta, S.A., Bagneux (France).
APPLICATION OF STRAIN GAGES AT HIGH TEMPERATURE, PART I: CEMENTS [L'EMPLOI DES JAUGES DE DEFORMATION A HAUTE TEMPERATURE]
B. Legrand, J. Toux, P. Bonnet and M. Grin (EURATOM) Brussels, EURATOM, Aug. 1965 31 p In FRENCH; ENGLISH summary
(Contract EURATOM-075-62-7 ORGF)
(EUR-2473.f) CFSTI: HC $2.00/MF $0.50

The authors are studying the application of strain gages at high temperature: they present here the results concerning the cements. Some commercial cements have been tested under mechanical and thermic stresses. The value of resistance to isolation of the cements in dependence on temperature has been plotted. At temperatures higher than 500°C practically no cement has a resistance to ground sufficient for precise measurements in connection with strain gages. Author

N66-10593# European Atomic Energy Community, Brussels (Belgium).
MODULAR COUNTING SYSTEM IN THE ELECTRONIC SECTION [SISTEMA MODULARE DI CONTEGGIO DELLA SEZIONE ELETTRONICA]
C. Colombo and L. Stanchi Jun. 1965 15 p In ITALIAN; ENGLISH summary
(EUR-2444.i) CFSTI: HC $1.00/MF $0.50

The modular counting system used in nuclear detection measurements is briefly described. The instruments are built according to Esone System; they are designed with the aim to allow many different connections for the particular experiments in a very general way. Some types of lay-out are shown and the main characteristics of all the units are given. Author

N66-10605*# Parametrics, Inc., Waltham, Mass.
ULTRASONIC TEMPERATURE MEASURING DEVICE First Quarterly Progress Report
E. H. Carnevale, L. C. Lynnworth, S. L. Klaidman Oct. 1965 18 p refs
(Contract NAS3-7981)
(NASA-CR-54780) CFSTI: HC $1.00/MF $0.50 CSCL 14B

During the first quarter, work proceeded as scheduled on room and elevated temperature preliminary ultrasonic measurements, and capsule design, construction and testing (nonradiation tests only). The analysis and experiments so far reveal no difficulties not originally anticipated. Radiation effects, including transmutations, are expected to be insignificantly small. Ultrasonic transmission tests indicate that "lead-in" wires at least 40 ft. long can be used between the transducer coils and the sensor element. By slightly modifying the transducers and the pulsing unit, 1 in. sensors should be usable over the entire temperature range, together with an expected thermometry accuracy of about 1%. In preparation for the high temperature irradiation experiments, capsules have been designed, incorporating both gamma and electrical heating. These designs provide a high temperature soak due to gamma heating, plus electrical heating to raise temperatures to the maximum levels required. Author

N66-10616*# Honeywell, Inc., Minneapolis, Minn. Aeronautical Div.
GG159 MINIATURE INTEGRATING GYRO STERILIZATION EXPOSURE STUDIES AT 300°F Final Report
R. G. Baldwin 10 Sep. 1965 80 p Prepared for JPL *Its* Rept.-20023-FRI-8
(Contracts NAS7-100; JPL-950769)
(NASA-CR-67810) CFSTI: HC $3.00/MF $0.75 CSCL 14B

Final progress is reported on a program to determine the performance degradation of a GG159D-1 gas bearing spinmotor gyro after being thermally sterilized at 300° F for 36 hours. An extensive analysis and design study was conducted to determine the optimum materials required for the gyro. The gyro design was further developed and modified to accommodate the materials changes and withstand the 300° F environment. An experimental gyro (without spinmotor) was fabricated and tested to evaluate the materials and design changes during sterilization cycling. One GG159D-1 gyro was fabricated and tested. Gyro performance was evaluated throughout five thermal sterilization cycles and the results are presented. R.N.A.

N66-10648*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DEVELOPMENT OF DATA UNFOLDING TECHNIQUES FOR CONTOURED SEMICONDUCTOR NEUTRON SPECTROMETER Final Report
James A. Shannon 1 Jul. 1965 73 p refs
(Contract NAS8-11631)
(NASA-CR-67629) CFSTI: HC $3.00/MF $0.75 CSCL 18N

Calibration of the charge-sensitive amplifier of the system was performed by calibrating a pulse generator against the 5.476 MeV α particles from an Am^{241} source incident on a surface barrier type of solid state detector. The source and detector were virtually windowless and no correction for windows was made. The location of the charged particle bin boundaries at 1.34, 1.74, 2.14 MeV were in turn impressed on the pulse height analyzer of the system by adjusting the 10-turn helipot of the pulse generator. It was noted that from the specifications accompanying the charge sensitive amplifier this procedure was accurate to within 1.5%. The silicon detector was suitably biased and placed as close to the Pu-α-Be source as possible. The charge particle spectrum, $N(E_q)$, was displayed on a pulse height analyzer and recorded automatically with suitable equipment. The result of a 90-minute exposure was shown. R.W.H.

N66-10732# Pratt and Whitney Aircraft, Middletown, Conn.
ELECTRON MICROPROBE ANALYSIS OF HIGHLY RADIOACTIVE SAMPLES
V. G. Scotti, J. M. Johnson, and R. T. Cunningham 20 Sep. 1965 21 p refs Presented at the 14th Ann. X-ray Conf., Denver, 25 Aug. 1965
(Contract AT(30-1)-2789)
(CNLM-6352)

An electron beam microprobe analyzer, shielded and modified for the analysis of highly radioactive materials, is described. This work discusses the instrument selection requirements, shielding, and remote sample loading and focusing concepts. Experimental results are presented demonstrating the instrument's capability. Author

N66-10785# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD FOR SYNCHRONIZATION OF THE FILM TRANSPORT VELOCITY WITH THE IMAGE VELOCITY IN A SLOTTED AERIAL CAMERA
V. B. Kiselev 27 May 1965 6 p Transl. into ENGLISH from Soviet Patent No. 160944 (Appl. No. 823849/26-10, 8 Mar. 1963) 2 p
(FTD-TT-65-490/1+2; AD-620097)

The method of synchronizing the film transport rate in a slotted aerial camera with the rate of image movement is distinguished by the fact that in order to automatically eliminate the effect of errors in the operation of the transport mechanism of the camera, impulses are recorded on a magnetic track applied to the edge of the aerial film. These impulses are read-out by means of magnetic heads and compared in a signal comparison block with signals entering from an image rate sensor (as a function of height and flight speed for each moment of time). A command signal from the comparison block controls the rate of the transport mechanism motor. Author (TAB)

N66-10813# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR REGISTERING INTERNAL FRICTION IN METALS DURING HEATING
A. Ye. Fedorovskiy and V. N. Bykov 25 Aug. 1965 7 p Transl. into ENGLISH from Soviet Patent no. 161559 (Appl. no. 780952/25-8, 25 May 1962) 1 p
(FTD-TT-65-479/1+2+4; AD-620789)

Object of the Invention: Device for registering internal friction in metals when heated, with the aid of a coordinating registering device, based on auto-excitation of sample vibrations with its natural frequency, having an electromagnet or another vibration exciting device in electrical oscillations proportional to them in amplitude, characterized by the fact, that for the purpose of automating the registration process by maintaining constant vibration amplitude of the sample when changing the magnitude of its internal friction, into the amplifier circuit of the vibration exciter is connected an electron regulator, which serves for controlling the reverse motor, changing the amplification factor of the vibration exciter, into the circuit of which through a thermoconverter is connected one of the measuring systems of the coordinate device. Author (TAB)

N66-10815# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR MEASURING THE INDUCTION OF A PERMANENT MAGNET
S. T. Usatenko 4 Jun. 1965 5 p Transl. into ENGLISH from Soviet Patent No. 155541 (Appl. No. 758185126-10, 2 Jan. 1962) 2 p
(FTD-TT-65-187/1+2; AD-620155)

Object of the invention: A device for measuring the induction of permanent magnets with the aid of Hall's sensitive element which is distinguished by the fact that for the purpose of compensating the effect on Hall's sensitive element of the flux of the magnetizing coils in the circuit of the coils there is placed a shunt the potential terminals of which are included in the circuit of the measuring electrodes of Hall's sensitive element. Author (TAB)

N66-10829# Naval Research Lab., Washington, D. C. Inorganic and Nuclear Chemistry Branch.
INSTABILITY OF REFRACTORY METAL THERMOCOUPLES
B. E. Walker, Jr., C. T. Ewing, and R. R. Miller 26 Mar. 1965 15 p refs
(NRL-6231; AD-621484)

Thermoelectric instabilities of some refractory metal thermocouples have been studied in the temperature range 100 to 2000 C under vacuum and neutral atmospheres. The sources of instability were found to be complex, involving contamination from ceramic protection tubes and furnace environments, preferential volatilization, and various thermal anomalies such as recrystallization and phase changes in the refractory thermoelements. Refractory thermocouples and thermoelements were studied under a variety of conditions, and emf changes associated with each were noted. Recommendations were made for the selection and application of these thermocouples to attain maximum thermoelectric stability. Author (TAB)

N66-10854# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATIONS OF ELECTRONICS IN MEASUREMENTS TECHNIQUE
An Pei 2 Aug. 1965 12 p Transl. into ENGLISH from Wu Hsien Tien (China), no. 5, 1963 p 1-2
(FTD-TT-65-360/1+2+3+4; AD-619452)

Electronic instruments have common and highly advantageous applications in the measurement of certain nonelectrical quantities (such as time, speed and temperature). The paper presents an introduction to this subject. TAB

N66-10872# CTS Knights, Inc., Sandwich, Ill.
HIGH PRECISION 5 MC QUARTZ RESONATORS. Report VII, 10 Dec. 1964-10 Mar. 1965
[1965] 20 p
(Contract NObsr-89290)
(AD-619734)

Tests of production units for temperature coefficient of frequency and preliminary aging tests are described. Author (TAB)

N66-10879*# Giannini Controls Corp., Duarte, Calif. Control/Nucleonics Div.
FEASIBILITY STUDY FOR AN X-RAY BACKSCATTER AIR DENSITY SENSOR Final Report
D. B. Hakewessell 8 Apr. 1964 126 p
(Contract NAS1-2306)
(NASA-CR-67729; GCC-ER-80157) CFSTI: HC $4.00/MF $1.00 CSCL 14B

The study reported in this document pertains to the feasibility study for, and subsequent flight test of a free air density sensor suitable for use on vehicles operating at velocities up to 24 000 feet per second at altitudes up to 300,000 feet. The sensor operates on the principal that the intensity of backscattered X-radiation is related to the density of the free air being measured. Author

N66-10901# Aeronautical Research Council (Gt. Brit.)
A DISCUSSION OF PITOT-STATIC TUBES AND OF THEIR CALIBRATION FACTORS WITH A DESCRIPTION OF VARIOUS VERSIONS OF A NEW DESIGN
C. Salter, J. H. Warsap, and D. G. Goodman May 1962 51 p refs Supersedes NPL-AERO-1013; ARC-23760
(ARC-R&M-3365; NPL-AERO-1013; ARC-23760) CFSTI: HC $3.00/MF $0.50

The report describes experiments devised to investigate some of the previously unexplained peculiarities of normal types of pitot-static tubes. Revised basic calibration factors for various instruments are recorded. In the process use was made of a special design of standard *static-pressure* tube, and the experiments led to new alternative types of *pitot-static* and plain *static-pressure* instruments. These have nose profiles of modified-ellipsoidal shape. In the report particular attention is given to the implications of the term 'calibration factor', to the special features and limitations of various types of instruments to the details and precautions of experimental technique for reliable investigations, and to the inclusion of generally associated information and comment. Author

N66-10909# RAND Corp., Santa Monica, Calif.
HOW GOOD IS THE LUNIK III MOON PHOTOGRAPHY?
Merton E. Davies 4 Jan. 1960 8 p
(P-1892; AD-616509)

In a previous paper, 'Lunar Exploration by Photography from a Space Vehicle,' the author discussed a photographic system for obtaining high-quality pictures of the moon. Included was a comparison of the surface detail yielded by astronomical lunar photography with that afforded by conventional aerial photography. It is the purpose of the present paper to compare the quality of the released Soviet pictures of the back side of the moon with that of conventional, earth-originated photographs of the front side. Author (TAB)

N66-10936*# National Bureau of Standards, Washington, D. C.
ACCURATE REFLECTANCE MEASUREMENTS: AN ELLIPSOIDAL MIRROR REFLECTOMETER
Jun. 1965 5 p
(NASA Order R-09-022-032)
(NASA-CR-67930; STR-3186) CFSTI: HC $1.00/MF $0.50 CSCL 20F

An ellipsoidal mirror reflectometer capable of measuring most defined reflectances accurately within 1% from 0.4 to 10μ for all engineering materials regardless of their level of reflectances or the geometric distribution of their reflected fluxes, is described. The reflectometer may be used to measure bi-directional, directional hemispherical, and directional annular cone reflectance; and the specular and diffuse components of reflectance. The instrument has the following two major components: an ellipsoidal mirror 12-1/4-in diameter and 3-5/8-in high, and a detector which views the interior of a sulfur coated averaging sphere. Two methods may be used to determine directional hemispherical reflectance with this instrument. In the first method, absolute directional hemispherical reflectance is computed as the ratio of incident flux, measured at the first focal point, to the reflected flux, measured at the second focal point. In the second method, reflectance is determined by comparing the flux reflected by a sample to that reflected by a specular reflectance standard. Included are data on inherent factors contributing to the accuracy of the instrument. S.C.W.

N66-10966# Argonne National Lab., Ill.
A NEUTRON MONITOR FOR SIMULTANEOUS MEASUREMENT OF FLUENCE AND DOSE EQUIVALENT
Robert F. Dvorak and Norman C. Dyer Aug. 1965 14 p refs
(Contract W-31-109-ENG-38)
(ANL-7085) CFSTI: $1.00

A neutron detector which has application as both an area monitoring instrument and a criticality dosimeter is under development. The detector simultaneously measures both dose equivalent and fluence from an exposure to fast neutrons. The moderator consists of a 12-in.-diameter, aluminum-encased paraffin sphere. The neutron sensors are nine thermal activation foils located within the moderator. The neutron fluence is determined by activation of six foils symmetrically located one inch below the surface of the moderator. For this foil array, the summed activity is nondirectional and proportional to the fluence within 10 percent over the investigated energy range from 20 keV to 2.3 MeV. The neutron dose equivalent is determined from activation of three symmetrically interlocked foils at the center of the moderator, and the summed activity is proportional to the dose equivalent within 75 percent over the same energy range. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N66-10051# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
REMOTELY OPERATED SPECIAL EQUIPMENT, VOLUME I, PARTS I AND II
[1964] 404 p refs Proc. of the 1964 Seminars Held at AEC Headquarters, Germantown, Md., 26-27 May 1964
(Conf-640508) CFSTI: $4.00

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1. ANALYSIS OF HOSTILE-ENVIRONMENT METHODOLOGIES J. W. Clark (Battelle Memorial Inst.) p 4-26 (See N66-10052 01-05)

2. SOME WORK ON MANIPULATOR SYSTEMS AT ANL PAST, PRESENT, AND A LOOK AT THE FUTURE R. Goertz (Argonne Natl. Lab.) p 27-74 (See N66-10053 01-15)

3. RATE CONTROLLED MANIPULATORS D. F. Melton (Programmed and Remote Systems Corp.) p 75–99 (See N66-10054 01-15)

4. A STUDY TO INVESTIGATE THE FEASIBILITY OF UTILIZING ELECTRICAL POTENTIALS ON THE SURFACE OF THE SKIN FOR CONTROL FUNCTIONS L. Harrison (Philco Corp.) p 100–157 (See N66-10055 01-05)

5. DESIGN AND TEST OF A FULL-SCALE WEARABLE EXOSKELETAL STRUCTURE N. J. Mizen (Cornell Aeron. Lab.) p 158–197 refs (See N66-10056 01-05)

6. HUMAN FACTORS IN REMOTE HANDLING: A REVIEW OF PAST AND CURRENT RESEARCH AT THE 6570TH AEROSPACE MEDICAL RESEARCH LABORATORIES W. N. Kama (Aerospace Med. Div. Aerospace Med. Res. Labs.) p 198–209 refs (See N66-10057 01-05)

7. A SERVO-RESTRAINT SYSTEM FOR ANTI-G PROTECTION W. L. Loudon (Naval Air Develop. Center) p 210–223 (See N66-10058 01-05)

8. CONTROL: THE UNIVERSAL PROCESS R. Wirta and R. Sprince (Philco Corp.) p 224–232 (See N66-10059 01-05)

9. AN EVALUATION OF PROPOSED APPLICATIONS OF REMOTE HANDLING IN SPACE G. P. Chubb (Aerospace Med. Div. Aerospace Med. Res. Labs.) p 233–247 refs (See N66-10060 01-05)

10. ADVANCED DESIGN CONCEPTS FOR A REMOTELY OPERATED MANIPULATOR SYSTEM FOR SPACE-SUPPORT OPERATIONS C. E. Vivian, W. H. Wilkins, and L. L. Haas (Lockheed Missiles and Space Co.) p 248–303 (See N66-10061 01-31)

11. PROGRAMMING AND MANUAL CONTROL OF VERSATILE MANIPULATOR DEVICES F. Holzer (Am. Machine and Foundry Co.) p 304–326 (See N66-10062 01-15)

12. USAF EXPLORATORY DEVELOPMENT OF REMOTE HANDLING EQUIPMENT R. L. Tolliver (AFSC, Kirtland AFB) p 327–333 (See N66-10063 01-15)

13. EVOLUTION OF REMOTE HANDLING CAPABILITIES AT NRDS M. J. Neder and C. D. Montgomery (Aerojet-Gen. Corp.) p 334–339 (See N66-10064 01-13)

14. ARCHITECT-ENGINEERING CONSIDERATIONS IN THE DESIGN OF REMOTE HANDLING TOOLS AS TO FUNCTION AND FLEXIBILITY J. E. Colgan, Jr. (Vitro Eng. Co.) p 340–364 (See N66-10065 01-15)

15. RECOMMENDATIONS AND DISCUSSION BY PARTICIPANTS REGARDING FUTURE RESEARCH AND DEVELOPMENT WORK p 364–379 (See N66-10066 01-15)

16. MANIPULATORS AND UPPER-EXTREMITY PROSTHETICS E. F. Murphy (Veterans Admin.) p 380–390 refs (See N66-10067 01-05)

N66-10053 Argonne National Lab., Ill. Remotely Controlled Engineering Div.

SOME WORK ON MANIPULATOR SYSTEMS AT ANL PAST, PRESENT, AND A LOOK AT THE FUTURE

Ray Goertz *In* AEC Remotely Operated Special Equipment [1964] p 27–74 (See N66-10051 01-15) CFSTI: $4.00

The development of remotely controlled manipulators, viewing devices, and associated equipment which can be manually operated to perform a wide variety of handling tasks and manipulations are reviewed. Two types of remote handling systems are examined. One of these is the velocity controlled unilateral electric manipulator and the other is the mechanical or electric master-slave manipulator. The use of these systems in conjunction with television cameras and monitors is also discussed. Pictures, sketches, and schematic drawings of many of the systems considered are included. M.R.W.

N66-10054 Programmed and Remote Systems Corp., St. Paul, Minn.

RATE CONTROLLED MANIPULATORS

Donald F. Melton *In* AEC Remotely Operated Special Equipment [1964] p 75–99 (See N66-10051 01-15) CFSTI: $4.00

Rate controlled manipulators for performing handling operations in hazardous environments are investigated. A brief discussion of other manipulator types, uses, mountings, and operating conditions is also given. The rate controlled manipulator is distinguished from other types of manipulators by means of the control system. In the rate controlled manipulator the rate, or velocity, of the controlled element is a function of the position of the controlling element. Some of the design and operational features are described. The use of remotely operated equipment in prosthetic applications is considered and discussed. M.R.W.

N66-10062 American Machine and Foundry Co., Greenwich, Conn. Atomics Div.

PROGRAMMING AND MANUAL CONTROL OF VERSATILE MANIPULATING DEVICES

Franz Holzer *In* AEC Remotely Operated Special Equipment [1964] p 304–326 (See N66-10051 01-15) CFSTI: $4.00

A report on the utilization of programmed subroutines in the control of versatile remotely operated manipulating devices is presented. Two programmed manipulators, the VERSATRAN and the FLEXIMAN are described in detail. Cost, compactness, and reliability are a few of the factors considered in the development of these devices and a discussion on these requirements is given. M.R.W.

N66-10063 Air Force Systems Command, Kirtland AFB, N. Mex.

USAF EXPLORATORY DEVELOPMENT OF REMOTE HANDLING EQUIPMENT

Robert L. Tolliver *In* AEC Remotely Operated Special Equipment [1964] p 327–333 (See N66-10051 01-15) CFSTI: $4.00

The design and construction of a specialized mobile manipulating system for the recovery of aerospace nuclear power devices is investigated. This remotely controlled vehicle, capable of accomplishing efficient remote-handling operations under emergency conditions in a high radiation environment, consists of an Army XM47E2 aluminum chassis on which are mounted a pair of identical 18 foot, 500 pound capacity manipulators, with a hand gripping power of 3,000 pounds. The manipulator's main tool is a plasma-arc cutting torch, developing a temperature of 50 000° F and capable of cutting almost any material at extremely high speeds. The vehicle, TV cameras, and manipulators are remotely operated from a command control van. A detailed description of the manipulator units, control systems, and the three-dimensional or stereoscopic television viewing system is also included. M.R.W.

N66-10065 Vitro Engineering Co., New York.

ARCHITECT-ENGINEERING CONSIDERATIONS IN THE DESIGN OF REMOTE HANDLING TOOLS AS TO FUNCTION AND FLEXIBILITY

James E. Colgan, Jr. *In* AEC Remotely Operated Special Equipment [1964] p 340–364 (See N66-10051 01-15) CFSTI: $4.00

Considerations in the design and installation of remote handling devices, manipulator systems, and remotely controlled tools are examined in terms of the responsibility of the architect-engineer to integrate the equipment to the building and the specific operations to be performed. Three types of

systems, ranging from small to large and from simple to complex are discussed in terms of their design, function, and operations: a university gamma cell, a power reactor refueling system, and a wall mounted handling system for the NERVA program. M.R.W.

N66-10076# Nuclear Metals, Inc., Concord, Mass.
TECHNICAL PAPERS OF THE SEVENTEENTH METALLOGRAPHIC GROUP MEETING
H. Roth Roman comp. Oak Ridge, Tenn., AEC, 1 Apr. 1965 146 p refs meeting held at Los Alamos Sci. Lab., N. Mex., 21–23 May 1963
(NMI-4999; CONF-105) CFSTI: $5.00

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2. METALLOGRAPHY OF THERMIONIC CONVERSION COMPONENTS T. I. Jones (Los Alamos Sci. Lab.) p 10–25 (See N66-10078 01-15)

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8. REPLICATION OF IRRADIATED SPECIMENS WITH ROOM-TEMPERATURE VULCANIZING SILICONES E. J. Manthos (Oak Ridge Natl. Lab.) p 69–77 refs (See N66-10084 01-15)

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10. SPECIMEN PREPARATION FOR TRANSMISSION ELECTRON MICROSCOPY OF ALPHA URANIUM D. L. Douglass (Los Alamos Sci. Lab.) p 85–86 refs (See N66-10086 01-17)

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12. METALLOGRAPHY OF URANIUM CONTAINING SMALL ADDITIONS OF IRON, SILICON, OR ALUMINUM C. L. Angerman and M. R. Louthan, Jr. (Du Pont De Nemours (E. I.) & Co.) p 94–103 refs (See N66-10088 01-17)

13. PLUTONIUM METALLOGRAPHIC PRACTICES AT BATTELLE R. H. Snider, V. W. Storhok, and M. S. Farkas (Battelle Memorial Inst.) p 104–109 (See N66-10089 01-15)

14. A NEW MICROHARDNESS TECHNIQUE T. M. Kegley, Jr. and B. C. Leslie (Oak Ridge Natl. Lab.) p 111–128 refs (See N66-10090 01-15)

15. A PORTABLE METALLOGRAPHY LABORATORY R. S. Crouse (Oak Ridge Natl. Lab.) p 129–136 (See N66-10091 01-11)

16. METALLOGRAPHY OF POWDER MATERIALS T. I. Jones (Los Alamos Sci. Lab.) p 137–157 (See N66-10092 01-15)

17. LIST OF ETCHANTS p 158

N66-10077 Iowa State Univ. of Science and Technology, Ames.
INVESTIGATION OF VIBRATORY POLISHING VARIABLES
E. N. Hopkins and D. T. Peterson *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 1–9 refs (See N66-10076 01-15) CFSTI: $5.00

Several variables in vibratory polishing have been investigated. The characteristics of the sample polishing varied with the lapping material, abrasives, sample weight, and voltage. Author

N66-10078 Los Alamos Scientific Lab., N. Mex.
METALLOGRAPHY OF THERMIONIC CONVERSION COMPONENTS
T. I. Jones *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 10–25 Sponsored by AEC (See N66-10076 01-15) CFSTI: $5.00

Modification of standard preparation procedures was required to evaluate the very hard components and dissimilar materials used in a design for thermionic conversion. Author

N66-10080 General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
POST IRRADIATION METALLOGRAPHIC LABORATORY AT GE-NMPO
S. A. Leighton and E. W. Filer *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 30–50 (See N66-10076 01-15)
(TM-63-5-9) CFSTI: $5.00

The construction of the cell and equipment used in preparing irradiated materials for metallographic evaluation are discussed. The mounting, grinding, polishing, etching and photomicrographic procedures used in preparing the various metallic and ceramic materials are given along with representative results. The various pitfalls to be avoided are stressed. The methods used and the results obtained in replicating materials remotely for electron microscopic studies are discussed. Author

N66-10081 Hanford Atomic Products Operation, Richland, Wash.
USE OF AUTORADIOGRAPHY IN A MICROSAMPLING OF IRRADIATED CERAMIC FUEL ELEMENTS
R. Teats *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 51–53 (See N66-10076 01-15) CFSTI: $5.00

The article describes a new technique for making autoradiographs of irradiated ceramic elements using photographic plates. The autoradiograph shows in good detail the distribution of fission products and is used in accurate micro sampling of the element. Author

N66-10082 Battelle Memorial Inst., Columbus, Ohio.
ONE-STEP REPLICATION IN THE HOT CELL
F. E. Mc Grath *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 54–59 (See N66-10076 01-15) CFSTI: $5.00

A technique for obtaining replicas from irradiated material for direct examination is described. The use of this method represents considerable savings of time as compared to the triple replication technique. Author

N66-10084 Oak Ridge National Lab., Tenn.
REPLICATION OF IRRADIATED SPECIMENS WITH ROOM-TEMPERATURE VULCANIZED SILICONES

E. J. Manthos *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 69–77 refs (See N66-10076 01-15) CFSTI: $5.00

Techniques for the replication of irradiated specimens with room-temperature vulcanizing silicones are described. Both unmounted and metallographically mounted specimens have been replicated. Silicone rubber molds of the specimen surfaces are cast in the hot cells and, after curing, the molds are removed from the specimens and decontaminated. Positive epoxy replicas are then prepared from the silicone rubber molds in a semi-hot area. The replicas may be used for the verification of hot cell observations and are very useful as models for the location of saw cuts during sectioning of metallographic specimens. Difficulties encountered in the preparation and decontamination of the silicone rubber molds are described, and advantages and disadvantages of the material are discussed. Author

N66-10085 Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
PREPARATION OF THIN FOILS OF URANIUM
C. L. Angerman *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 78–84 refs (See N66-10076 01-15)
(Contract AT(07-2)-1) CFSTI: $5.00

Foils of uranium suitable for direct observation in the electron microscope were prepared by electropolishing first in a solution containing phosphoric acid, ethylene glycol, and ethyl alcohol and then in a solution containing sulphuric acid, glycerine, and water. Twins, line dislocations, and dislocation loops were observed in typical samples. Author

N66-10087 Battelle Memorial Inst., Columbus, Ohio.
METALLOGRAPHY OF URANIUM NITRIDE
W. Musser, J. Bugl (EURATOM), and A. A. Bauer *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 87–93 (See N66-10076 01-15) CFSTI: $5.00

Procedures for the metallographic preparation of UN samples are described. These include cutting, mounting, and grinding procedures as well as chemical, electrochemical, and vacuum-cathodic etching techniques. Author

N66-10089 Battelle Memorial Inst., Columbus, Ohio.
PLUTONIUM METALLOGRAPHIC PRACTICES AT BATTELLE
R. H. Snider, V. W. Storhok, and M. S. Farkas *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 104–109 (See N66-10076 01-15) CFSTI: $5.00

A wide variety of plutonium-bearing materials have been prepared for metallographic examination. Operating philosophy, equipment, general metallographic procedures as well as specific techniques for such materials as oxides, nitrides, and several metallic alloys are described. Author

N66-10090 Oak Ridge National Lab., Tenn.
A NEW MICROHARDNESS TECHNIQUE
T. M. Kegley, Jr. and B. C. Leslie *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 111–128 refs (See N66-10076 01-15) CFSTI: $5.00

Conventional microhardness tests using Kentron and Tukon hardness testers are not adequate for resilient materials such as pyrolytic carbon and pyrolytic graphite, since hardness indentations made on such materials vanish upon removal of the test load. However, if a thin pyroxylin film is placed on the specimen before making the microhardness test, then an image of the indentation is retained on the film. The technique that was developed for coating the pyroxylin film on the specimen so as to record the hardness indentations and some of the test results are described. Author

N66-10092 Los Alamos Scientific Lab., N. Mex.
METALLOGRAPHY OF POWDER MATERIALS
T. I. Jones *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 137–157 Sponsored by AEC (See N66-10076 01-15) CFSTI: $5.00

Metallography has proven to be a useful technique for the evaluation of powder materials. In many instances, reevaluation of particle size measurements and chemical and X-ray data results from metallographic examinations. Author

N66-10238* Radio Corp. of America, Princeton, N. J.
RELIABILITY PROGRAM
H. F. Wuerffel, R. A. Smith, L. Gomberg, and D. F. Metz *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 261–271 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1272)

Component part reliability, system reliability analysis, conservative design, rigorous testing, and quality control provided the basis for the overall reliability program for Relay I. A description is given of the spacecraft mission profile and the parts program. It is emphasized that redundancy was incorporated at all levels of the development program to determine the inherent reliability of the spacecraft. Two separate models and a composite of the two were developed to determine the reliability of three modes of transmission. Malfunction data reporting and analysis were made to determine if the final product had the reliability designed into the circuit and to eliminate problems arising from design, system integration, and testing. In spite of these preliminary tests, the inability to turn off one of the high power regulators and its associated wideband repeater was not discovered until the Relay spacecraft was in orbit. This malfunction was related to excessive reverse leakage current and dew point. Vendor control, preconditioning, product quality control, manufacturing environment and handling, and log books are discussed. M.W.R.

N66-10318*# National Aeronautics and Space Administration. Goddard Space Flight Center Greenbelt, Md.
SELECTIVE ELECTROPLATING OF ETCHED CIRCUITS
Charles E. Whitfield, Sr. and Howard Herzig Washington, NASA, Nov. 1965 8 p refs
(NASA-TM-X-1168) CFSTI: HC $1.00/MF $0.50 CSCL 07A

A selective electroplating technique was developed for producing etched copper circuit boards (which are commonly gold plated to prevent tarnishing of the copper) on which only the conductive paths between terminals are gold plated, the pads themselves being plated with a more suitable metal. Separate positive films of the conductor and terminal pad patterns are used to sequentially produce the photoresist masks required for the plating of each area with its respective metal. A negative of the entire circuit is then used to produce a new new photoresist mask covering the circuit, so that the unwanted copper can be etched away. The technique should avoid the waste of time and material involved in the normal procedure for removing the gold from the terminal pads to which components are connected in order to achieve reliable soldered joints. L.S.

N66-10333*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDY OF END EFFECT AND PRESSURE PATTERNS IN HELICAL GROOVE FLUID FILM SEAL (VISCOSEAL)
Lawrence P. Ludwig, Thomas N. Strom, and Gordon P. Allen Washington, NASA, Nov. 1965 22 p refs
(NASA-TN-D-3096) CFSTI: HC $1.00/MF $0.50 CSCL 11A

An experimental investigation was conducted on the pressure patterns in a viscoseal consisting of a smooth rotor and a stationary helically grooved housing. The sealed fluid was a mineral oil, and the investigation was within the laminar-flow regime (maximum Reynolds number of 300). Results indicated that when the grooves communicated directly with the pressurized cavity, an end effect, or ineffective seal length, was evidenced by a sharp decay of pressure along the land leading edge. This end effect was eliminated by incorporating a short dam which blocked direct communication of the groove with the pressurized cavity. Measurements of pressure patterns within the viscoseal confirmed existing theoretical predictions of linear pressure gradients and disclosed a method of applying the theoretical pressure generation equation to determine wetted-seal length. Author

N66-10344# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF MELTING METALS IN VACUUM FURNACES
V. V. Bashenko, A. V. Donskoy, and D. G. Ratnikov 24 Aug. 1965 4 p Transl. into ENGLISH from Soviet Patent No. 166977 (Appl. No. 797782/24-7, 9 Oct. 1962) 1 p
(FTD-TT-65-471/1+2+4; AD-620790)

The object of the invention is a method of melting metals in vacuum furnaces. Combined electron and induction heating of metals is used to increase the efficiency of the furnaces. Author (TAB)

N66-10361 Joint Publications Research Service, Washington, D. C.
SPECIAL FEATURES OF HOT ROLLING REFRACTORY METALS IN VACUUM AND INERT GAS ATMOSPHERE
Ya. B. Gurevich, A. P. Bashchenko, and V. L. Orzhekhovskiy *In its* Studies in the Melting and Hot-Rolling of Titanium and Zone Segregation of Titanium Alloy Ingots 29 Oct. 1965 p 8-18 refs (See N66-10359 01-17) CFSTI: $2.00

Hot rolling of pure titanium, molybdenum, niobium, and chrome in a vacuum, and in an inert argon atmosphere was studied. All specimens showed surface scale formation after heating in air; heatup in argon led to a slight weight increase of the titanium and niobium test specimens. A vacuum of about 133.3×10^{-5} newt/m^2 provided almost complete protection from gas saturation. It was found that hot rolling in an extreme vacuum of about 133×10^{-5} newt/m^2 of titanium, niobium, and chromium preserved the purity of the starting material, insured higher workability, induced better durability for further cold or hot rolling, and assured a good surface quality of the rolled metals. Molybdenum required an atmosphere of technically pure inert gas, or a shallow vacuum of about 133×10^{-2} newt/m^2 to insure good tensile properties. G.G.

N66-10375# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A NOTE ON A PROCESS FOR THE MANUFACTURE OF FERROMAGNETIC RINGS
Shien-hua Wu 25 Jun. 1965 4 p Transl. into ENGLISH from Tzu Tung Hua (China), v. 3, no. 3, 1960 p 113
(FTD-TT-64-1338/1+2+4; AD-620062)

A method for manufacturing the Mn-Mg ferromagnetic rings is presented. The ferromagnetic ring with a parrallelogram-shaped hysteresis loop is used in non-contact power generating systems. The rings are manufactured by a powder metallurgical method. TAB

N66-10420*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SLIP IN TUNGSTEN AT HIGH TEMPERATURES
Jack L. Taylor 15 Oct. 1965 16 p refs
(Contract NAS7-100)
(NASA-CR-67699; JPL-TR-32-818) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Singlw crystals of tungsten grown from powder-metallurgy swaged rod by high temperature annealing were deformed in tension at temperatures from 2500 to 5000° F. Orientation of specimen tensile axis, strained matrix, and deformation bands was determined optically by reflections from {110} etch pits. Slip traces were analyzed and slip direction determined. Results indicate that $\{110\}\langle 111\rangle$, $\{112\}\langle 111\rangle$, and $\{123\}\langle 111\rangle$ type slip occur in tungsten over the temperature range investigated. Slip is orientation dependent occurring on that combination of slip plane and direction which has the highest critical resolved shear stress. "Overshooting" appears to be a general occurrence between 2500 and 5000° F. Deformation bands show rotation in a direction opposite to the rotation of the tensile axis. Author

N66-10439# Royal Radar Establishment, Malvern (England).
THE PREPARATION OF THIN SEMICONDUCTOR SAMPLES FOR OPTICAL WORK
S. C. J. Brooke, J. E. Quarrington, and N. Williams Oct. 1962 11 p refs
(RRE-MEMO-1948)

Techniques are described for producing specimens of certain semiconductors suitable for spectroscopic experiments. The specimens consist of plane parallel plates with a good optical polish on both faces. The stages in their preparation from the bulk material are outlined and practical details in each stage are included. R.N.A.

N66-10521# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Munich (West Germany). Institut für Flugtreib und Schmierstoffe.
LUBRICATION AT SPACE CONDITIONS [SCHMIERUNG UNTER WELTRAUMBEDINGUNGEN]
G. Spengler and F. Wunsch Aug. 1965 118 p refs In GERMAN; ENGLISH summary
(DVL-434; DLR-Mitt-65-07) CFSTI: HC $4.00/MF $0.75

Operation of equipment in space vehicles has created new requirements on lubricants. The lubricants are subject to additional influences, such as zero gravity, meteorites, various forms of radiation energy, temperature extremes, and ultra-high vacuum. The paper critically reviews the literature on the development and testing of suitable lubricants. Author

N66-10563# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELECTION OF FLUX FOR WELDING HIGH-STRENGTH STEEL
K. V. Lyubavskiy, B. N. Bad'yanov, and Z. D. Klestova 13 May 1965 13 p refs Transl. into ENGLISH from Svarochnoye Proizvodstvo (USSR), no. 10, 1964 p 6-9
(FTD-65-49/1+2; AD-616281)

The effect of flux composition on the oxidation of the seam and its mechanical properties when welding 25-KHSNVFA steel was investigated. Author (TAB)

N66-10574# Rocketdyne, Canoga Park, Calif.
MULTISTAGED RADIAL IMPELLER PUMP Progress Report
15 Sep. 1965 57 p
(Contract AF 04(611)-10547)
(R-6301; AD-470808)

A description of the design and the work accomplished during the first half of the contract period on the multistaged radial impeller, high-pressure liquid hydrogen pump is presented. The design is complete and the pump hardware is approximately 95% complete. A complete hydrodynamic redesign of the proposed pump was required from the impulse blade discharge to the volute discharge flange. Additional mechanical redesigns and material changes were also required to maintain thermal construction compatability. Author (TAB)

N66-10632*# Battelle Memorial Inst., Columbus, Ohio.
A STUDY TO DEVELOP A MECHANIZED WELDING PROCEDURE TO JOINT THICK-GAGE ALUMINUM ALLOY PLATE USING NARROW-GAP TECHNIQUES Final Report
D. E. Conklin, R. P. Meister, R. E. Monroe, and D. C. Martin
31 Jan. 1965 78 p refs
(Contract NAS8-11102)
(NASA-CR-67760) CFSTI: HC $3.00/MF $0.75 CSCL 13H

A study was conducted to develop narrow-gap welding procedures for joining thick gage 2219 aluminum alloy plate. The basic welding equipment setups were made of commercial gas-shielded metal-arc welding components. A number of different joint designs were used: for welds made from one side of the plate, the joint design consisted of either a square-butt joint with a backing strip or a narrow U-joint with parallel sidewalls; the joint designs used on plates welded from two sides were double U-joints with 0 to 6 degree included angles. Three different narrow-gap techniques were used for depositing the welds; the single wire centered, the single wire offset, and the twin wire method. The welding conditions were set by varying the welding parameters over a wide range. Testing consisted of visual observations; radiographic and metallographic examinations; and hardness, tensile, and bend tests. A detailed discussion of results, conclusions, and recommendations is included. C.T.C.

N66-10658# Officine di Villar Perosa, S.p.A., Turin (Italy). Sezione Calibri e Strumenti.
HANDLING "FLUIDICS" FOR PRACTICAL APPLICATIONS, PAPER E5
M. Monge [1965] 23 p Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and the Coll. of Aeron., Cranfield, England, 8-9 Sep. 1965
CFSTI: HC $1.00/MF $0.50

Fluidic components and circuits designed and built for field applications in several industrial areas, are described. The peculiarities and features of the solutions adopted and methods chosen for carrying them into effect, can be gathered from these short descriptions. Author

N66-10663# Los Alamos Scientific Lab., N. Mex.
THE FABRICATION OF HOLLOW HEMISPHERES AND CYLINDERS OF TUNGSTEN CARBIDE-6 W/O COBALT
Haskell Sheinberg 11 Nov. 1964 21 p
(Contract W-7405-ENG-36)
(LA-3154) CFSTI: $1.00

This report describes the details of die design, the powder preparation and loading, and the hot pressing operations employed to fabricate two 15.53-inch O.D. X 10.20-inch-I.D. tungsten carbide-6 w/o cobalt hollow hemispheres with 3.95-inch-diameter polar cavities, and two 4.08-inch-diameter X 2.74-inch-long cylinders. The metallographic structure of the starting powder and of a core from one of the hot pressed hemispheres is described. Author

N66-10669*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
INVESTIGATION OF THE COEFFICIENT OF FRICTION OF VARIOUS GREASES AND DRY FILM LUBRICANTS AT ULTRA HIGH LOADS FOR THE SATURN HOLD DOWN ARMS
K. E. Demorest and A. F. Whitaker 14 Sep. 1965 34 p refs
(NASA-TM-X-53331) CFSTI: HC $2.00/MF $0.50 CSCL 11H

A series of high load, low speed sliding friction tests was made on 8 fluid lubricants and 18 dry lubricants at normal unit loads from 10,000 psi to 150,000 psi. Four different substrate materials having a range of hardnesses from Rockwell C 18 to Rockwell C 55 were used. The ultimate load capability of both fluids and dry films is a function of substrate hardness with the best ultimate load capability being provided by inorganically bonded molybdenum disulfide films with small amounts of graphite added. The coefficient of friction of the fluid lubricants appears to be an inverse function of substrate hardness and a direct function of the normal load. The coefficient of friction of the dry lubricants is an inverse function of the normal load, but it does not appear to be related to the substrate hardness. Author

N66-10818# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUBMERGED VIBROARC WELDING TECHNIQUE
G. A. Mirlin 27 May 1965 5 p Transl. into ENGLISH from Soviet Patent No. 153762 (Appl. No. 6023041 25, 11 Jun. 1958) 2 p
(FTD-TT-65-48811; AD-620080)

The object of the invention is a method of submerged vibroarc welding in which the electrode end makes an oscillatory motion of variable rate by means of a camdriven vibrator. In order to increase weld quality the electrode to the part will be greater than the rate of departure of the electrode from the part. Author (TAB)

N66-10843# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
ACCELERATED RELIABILITY TEST METHODS FOR MECHANICAL AND ELECTROMECHANICAL PARTS Technical Report, Dec. 1963-Jan. 1965
William Yurkowsky and R. E. Schafer Jul. 1965 246 p refs
(Contract AF 30(602)-3268)
(RADC-TR-65-46; AD-621074)

This study is addressed to the development of accelerated reliability test methods for long lived mechanical and electromechanical parts. The parts studied were a subminiature snap-action switch, a crystal can relay, a mechanical seal, and a rubber timing belt. The failure times of all parts fit Weibull distributions. Failure analysis data is presented. Several mathematical models are presented as tentative representations of the failure laws operating under conditions of combined stresses. The merits of each are investigated in relation to the data generated during this study. Author (TAB)

N66-10873# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FRICTION BEARING

Yu. A. Sokolov 23 Jul. 1965 3 p Transl. into ENGLISH from Soviet Patent no. 165042 (Appl. no. 850089 24-6, 27 Jul. 1963 2 p
(FTD-TT-65-517/1+2+4; AD-619468)

A friction (sliding) bearing for rapid-action machines, such as, a turbo compressor is described. The bearings contain a floating bushing with two surfaces of friction. The distinguishing feature for improving the antifriction qualities with great speeds of friction the inner surfaces of the sleeve and seat of the support are designed with V-shaped oil pockets. Author (TAB)

N66-10930*# Parker Aircraft Co., Los Angeles, Calif.
[ELECTRO-PNEUMATIC ACTUATION SYSTEM] Monthly Progress Report No. 7
29 Jan. 1965 34 p
(Contract NAS8-11662)
(NASA-CR-67921) CFSTI: HC $2.00/MF $0.50 CSCL 13H

In testing performed on a torque motor assembly to insure consistency of data, observations show reasonable hysteresis as evidenced by the cluster of data points; apparent substantiation of the computer analysis assumptions made for jet pipe characteristics; and evidence of potentially good second stage performance. Raw data sheets and computations are included. M.G.J.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N66-10395* Columbia Univ., New York. Columbia Radiation Lab.
AN OPTICALLY PUMPED Rb^{87} MASER OSCILLATOR
P. Davidovits *In* NASA. Goddard Space Flight Center Short-term Freq. Stability 1965 5 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50
(Contract DA-36-039-SC-90789)

A self-sustained Rb^{87} maser oscillator has been developed. The maser oscillates on the Rb^{87} hyperfine transition frequency (approximately 6,835 Mc/sec). Because of its simplicity and potential frequency stability, the device promises to be a very useful frequency standard. Author

N66-10581# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
STIMULATED RAMAN SCATTERING AND RELATED NONLINEAR OPTICAL EFFECTS
D. A. Sealer 31 Jul. 1965 132 p refs
(Contract AF 33(615)-2287)
(Rept.-1935-6; AD-470341)

Through stimulated Raman scattering an optical maser becomes a source of power for narrowband electromagnetic radiation at frequencies separated from the frequency of the optical maser by integral multiples of the frequency of a molecular vibrational resonance. The generation of radiation at these frequencies is accompanied by a power decrease in the optical maser beam. The significance of stimulated Raman scattering to active device research and development is that it is a means of producing well-collimated intense narrowband optical beams comparable to the output of an optical maser but at frequencies differing from those of the optical masers. Also, one must avoid establishing favorable conditions for the buildup of stimulated Raman scattering in optical systems in which only transmission of an intense optical beam is desired. Author (TAB)

N66-10583# Martin Co., Orlando, Fla.
LASERS AND THEIR EFFECTS Annual Progress Report, 1 Jul. 1963–1 Mar. 1964
James H. Burkhalter 1 Apr. 1964 50 p
(Contract DA-49-193-MID-2456)
(OR-3885; AD-433218)

The biological effects of lasers and laser radiation are described. Design and construction of a research laser and associated instrumentation is included. Important problems investigated for various biological researchers and the approaches used are discussed. Author

N66-10766# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
TECHNIQUES FOR SUPER-MODE OSCILLATION Interim Engineering Report, 1 Jun.–31 Aug. 1965
Russell Targ, S. E. Harris, and B. J. Mc Murtry [1965] 32 p refs
(Contract AF 33(615)-2884)
(IER-1; AD-620849)

The work of this program is divided broadly between two main activities. The first is to obtain a more complete understanding of the physics governing the operation of the FM and super-mode lasers. The second is concerned with improving the techniques for coupling the modes of the FM laser and finding more efficient means for full power supermode conversion of the FM signal to a monochromatic output. An FM modulator was designed and built for incorporation into the laser cavity which is approximately twenty times as efficient as the modulator used successfully in all previous FM experiments. This modulator will permit work with lasers having many more oscillating modes than was previously possible. An external modulator was designed to be used for supermode conversion. This modulator is expected to have ten times the modulating capability of the previous super-mode modulators, alloing work with much higher power lasers. Attempts were made to find alternate techniques for obtaining substantial power at a single frequency. TAB

N66-10779# California Inst. of Tech., Pasadena. Quantum Electronics Lab.
NONLINEAR EFFECTS IN TRAVELING WAVE LASER AMPLIFIERS Scientific Report No. 5
D. H. Close May 1965 216 p refs
(Contract AF 49(638)-1322)
(AFOSR-65-0999; AD-621320)

Using semiclassical radiation theory, a formalism similar to that used by Lamb in his 'Theory of an Optical Maser' is developed for studying the amplification of vector traveling waves in a laser-type medium. The effect of the medium on the waves is given in terms of space (or time) dependent field amplitudes and phases and a nonlinear index of refraction. With particular emphasis on typical gaseous media, the effects of Doppler broadening are treated in detail for arbitrary ratios of natural to Doppler linewidths. Polarization and propagation vectors in various directions are considered, and the nonlinear effects are found to make an isotropic medium effectively anisotropic. Lowest order nonlinear effects (due to a polarization cubic in the field amplitudes) are studied extensively, and the frequency dependence of several of these processes is presented in graphical form. In particular, the introduction of fields at new frequencies and polarization effects are considered. The characteristics of

these nonlinear processes peculiar to Doppler broadened lines are discussed, and the processes are interpreted in terms of saturation and coherent modulation of the population inversion density. TAB

N66-10969# California Univ., Livermore. Lawrence Radiation Lab.
THE EFFECT OF HIGH VELOCITY TRANSLATION ON PHOTON CORRELATIONS IN LASER INTERFEROMETERS
Thomas J. Burgess 17 Aug. 1965 13 p refs
(Contract W-7405-ENG-48)
(UCRL-14345)

It is shown that high velocity translation of one of the mirrors of a laser Michelson interferometer diminishes the correlation of the photons in the wave field. This diminution is manifested by deterioration of the visibility of interference effects. An expression is obtained for fringe visibility as a function of (1) the Doppler frequency-shift upon reflection from the moving mirror, (2) the line width of the laser Lorentzian spectral distribution, and (3) the optical path difference. The implications for pulsed displacement measurements are discussed. Author

N66-10972# AVCO-Everett Research Lab., Everett, Mass.
CONDITIONS FOR COHERENT AMPLIFICATION IN PULSED LASER ARRAYS
James C. Keck Oct. 1965 10 p refs
(AVCO-Everett Res. Rept.-233)

The growth of waves in a pulsed laser amplifier has been calculated using a quasi one dimensional model. Amplification of both externally impressed and spontaneously emitted waves has been considered and it is found that the external wave must have a certain minimum intensity to prevent dumping of the laser by the spontaneous emission. The implications of the theory for the pulsed N_2 laser currently operating are discussed. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N66-10086 Los Alamos Scientific Lab., N. Mex.
SPECIMEN PREPARATION FOR TRANSMISSION ELECTRON MICROSCOPY OF ALPHA URANIUM
Dana L. Douglass *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 85–86 refs Sponsored by AEC (See N66-10076 01-15) CFSTI: $5.00

A transmission electron microscopy study was made to investigate the effects of cold work and recrystallization on alpha uranium for the eventual purpose of making a transmission examination of thin films of plutonium. In the preparation of thin uranium films, use was made of an electropolishing bath composed of chromic acid, glacial acetic acid, and water. The standard window technique was employed, including masking the edges of the sample with a stop-off paint made of polystyrene dissolved in benzene. The electrolytic cell consisted of a cylindrical stainless steel cathode in a beaker containing the chromic-acetic acid solution. Upon completion of the thinning, the specimens were rinsed in anhydrous methanol and dried in a warm air stream. G.A.L.

N66-10088 Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
METALLOGRAPHY OF URANIUM CONTAINING SMALL ADDITIONS OF IRON, SILICON, OR ALUMINUM
C. L. Angerman and M. R. Louthan, Jr. *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 94–103 refs (See N66-10076 01-15) CFSTI: $5.00
(Contract AT(07-2)-1)

In uranium with alloying additions of up to 400 ppm Fe and up to 800 ppm of either Si or Al, the various U-containing phases were examined with the electron microscope. These phases were also extracted chemically and identified by electron diffraction. During γ-phase heat treatments, the alloying additions, as well as impurity atoms, segregate into networks of "incipient" precipitates that can be seen only after certain etching treatments. Author

N66-10098# Bureau of Mines, College Park, Md. College Park Metallurgy Research Center.
STRESS CORROSION CRACKING OF VANADIUM, MOLYBDENUM, AND A TITANIUM–VANADIUM ALLOY
J. P. Carter, C. B. Kenahan, and David Schlain 1965 21 p refs
(BM-RI-6680)

Vanadium, molybdenum, and a titanium-10 percent vanadium alloy were evaluated for their susceptibility to stress corrosion cracking in a number of corrodents. Tests were conducted utilizing conventional U-bend techniques with subsequent evaluation in a pneumatic constant-load apparatus. Vanadium and molybdenum were generally resistant to stress corrosion cracking in the media studied. U-bend specimens of vanadium showed evidence of stress corrosion cracking in 6 *N* hydrochloric and 18 *N* sulfuric acids; however, tensile stress specimens exposed to these solutions did not exhibit stress cracking. Similar results were obtained when U-bend specimens of molybdenum were immersed in 10 percent formic acid. Titanium-10 percent vanadium alloy was susceptible to stress corrosion cracking in 10-percent (2.85 *N*) hydrochloric acid solution. Heat treating the alloy greatly reduced its corrosion rate and its susceptibility to stress corrosion cracking in this medium. Author

N66-10207# General Electric Co., Cincinnati, Ohio. Atomic Products Div.
HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 50, Part A
20 Aug. 1965 81 p refs
(Contract AT(40-1)-2847)
(GEMP-50A) CFSTI: $3.00

Radiation effects, plastic fatigue properties, fission product transport processes, physico-chemical studies, and fuel element research are considered in a high temperature materials program. The effect of radiation on refractory metals and alloys is given; and includes creep rupture tests, irradiated tungsten hot hardness measurements, and studies of the transmutation of tungsten atoms into rhenium and osmium atoms. The results of creep-rupture tests are given for irradiated Hastelloy N specimens. The effects of radiation in BeO are presented and include modulus-of-rupture and thermal diffusivity measurements. Fission product transport processes were studied in refractory metal fuel systems. Physico-chemical studies are

reported for cladded UO_2 in potential meltdown environments and Fe-Cr-Al clad fuel systems. A study of the chemistry involved in the use of a fertile material (thoria) in stabilized fuel–BeO systems is included. C.T.C.

N66-10276*# National Aeronautics and Space Administration, Washington, D. C.
PHYSICAL METALLURGY OF TITANIUM
I. I. Kornilov, ed. Nov. 1965 358 p refs Transl. into ENGLISH from Works of the Fifth Conf. on Met., Phys. Met., and Appl. of Titanium and its Alloys (Moscow), Mar. 1963
(NASA-TT-F-338) CFSTI: HC $7.00/MF $1.75 CSCL 11F

Works of the Fifth Conference on Metallurgy, Physical Metallurgy, and Application of Titanium and its Alloys are presented. For individual titles see N66-10277–N66-10315.

N66-10277* National Aeronautics and Space Administration, Washington, D. C.
PROSPECTS FOR THE DEVELOPMENT OF INVESTIGATIONS OF THE HEAT RESISTANCE OF TITANIUM ALLOYS
I. I. Kornilov *In its* Phys. Met. of Titanium Nov. 1965 p 1–11 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Relationships are established which govern the dependence of the high temperature strength of titanium alloys on the nature of the interaction of the components with titanium, types of equilibrium diagrams of the systems, and the structure of the alloys. Experimentally obtained composition–high-temperature strength diagrams of certain simple and multicomponent titanium systems show it possible to use these relationships for the development of heat resistant titanium alloys having optimum properties. An important role in the creation of the alloys is played by the stable structures of α and β solid solutions, and also by metallic compounds of titanium and alloys based on these compounds. Promising in this respect are multicomponent α and β solid solutions of systems based on titanium, and the titanium compounds Ti_6Al and Ti_3Al, which are formed from α solid solutions of the Ti–Al system. Alloys made from these phases can have working temperatures between 600° C and 800° C. C.T.C.

N66-10278* National Aeronautics and Space Administration, Washington, D. C.
PHASE DIAGRAM OF THE SYSTEM Ti-O_2 AND SOME PROPERTIES OF THE ALLOYS OF THIS SYSTEM
I. I. Kornilov and V. V. Glazova *In its* Phys. Met. of Titanium Nov. 1965 p 12–28 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Methods of microstructural and X-ray structural analysis as well as measurements of microhardness, electrical resistance, and electrical conductivity are used to study the alloys of the Ti-O_2 system quenched after annealing at various temperatures in the concentration range of 0 to 35 atomic percent O_2. Results of these investigations and the composition-property diagrams obtained make it possible to establish the existence of compounds Ti_6O and Ti_3O. The concentration and temperature limits of these compounds are determined, and an equilibrium diagram of the Ti-O_2 system is proposed. The compound Ti_6O is stable up to 820° C to 830° C, while the compound Ti_3O is thought to be stable above 1400° F. Studies of the thermal expansion and hot hardness of the alloys of the system are given. The general nature of the influence of oxygen on the behavior of titanium under load at various temperatures is established, and a correlation between this dependence and the equilibrium phase diagram of the Ti-O_2 system is included. C.T.C.

N66-10279* National Aeronautics and Space Administration, Washington, D. C.
EQUILIBRIUM DIAGRAM OF THE QUATERNARY SYSTEM Ti=Al-Mo-V
E. N. Pylayeva and Ko Chih-Ming *In its* Phys. Met. of Titanium Nov. 1965 p 29–34 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

The ternary system Ti-Al-Mo and the system Ti-Al-(Mo:V=1:1) are investigated in order to study the phase equilibrium in the quaternary system Ti-Al-Mo-V. A concentration tetrahedron of this quaternary system is given, and shows the investigated portions. An examination of the isothermal sections of the Ti-Al-Mo and Ti-Al-(Mo:V=1:1) systems was made at 600° C, and compared with the system Ti-Al-V. Conclusions are that in the portion rich in titanium in these three systems, the same phase regions are in equilibrium. These regions are tabulated, and it is shown that in the phase equilibrium tetrahedron of the quaternary system Ti-Al-Mo-V, these regions shift steadily from the system Ti-Al-Mo via the intermediate system Ti-Al-(Mo:V=1:1) toward the system Ti-Al-V. A geometrical representation of the studied portion of the phase equilibrium tetrahedron at 600° C is given; this reveals the character of the interaction between the components, and shows the expansion of the phase regions in the quaternary system Ti-Al-Mo-V. C.T.C.

N66-10280* National Aeronautics and Space Administration, Washington, D. C
PHASE STRUCTURE OF ALLOYS OF THE SYSTEM Ti-Al-Cr-Si WITH A CONSTANT CONTENT OF ALUMINUM AND SILICON
V. S. Mikheyev and K. P. Myasnikova *In its* Phys. Met. of Titanium Nov. 1965 p 35–45 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

An investigation is presented of the phase equilibrium in alloys of the system Ti-Al-Fe-Cr-Si with constant aluminum and silicon content (7.5 and 0.3 wt percent, respectively). The starting materials and the method of preparation of the alloys are given. Methods of microstructural and X-ray analysis as well as measurements of heat treatment, electrical resistivity, and hardness are used in carrying out the study. The results are given along with graphs and tetrahedron isothermal sections. C.T.C.

N66-10281* National Aeronautics and Space Administration, Washington, D. C.
STUDY OF THE ALLOYS OF THE TERNARY SYSTEM Ti-Al-Zr
Ye. N. Pylayeva and M. A. Volkova *In its* Phys. Met. of Titanium Nov. 1965 p 46–52 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Microstructural and thermal analysis methods are used in a study of the alloys of the ternary system Ti-Al-Zr. The electrical resistivity and hardness were determined, and show the existence of a continuous series of solid solutions, with the exception of the $\alpha + \alpha_2$ region adjacent to the alloy. It is seen that all the alloys of the section studied undergo a polymorphic transformation analogous to the transformation in pure titanium, zirconium, and the Ti-Zr system. The change in the temperatures of the transformation occur along curves with a minimum (660° C, and approximately 65 percent Zr). The electrical resistivity and hardness of the alloys after quenching from 1100° C, 800° C, and 500° C changes along curves protruding upward; the maximum values of the hardness correspond to alloys quenched from the region of the β solid solution. C.T.C.

N66-10282* National Aeronautics and Space Administration, Washington, D. C.
PHASE EQUILIBRIUM OF ALLOYS OF THE SECTION Ti_3Al-Zr OF THE TERNARY SYSTEM Ti-Al-Zr
I. I. Kornilov, T. T. Nartova, and M. M. Savel'yeva *In its* Phys. Met. of Titanium Nov. 1965 p 53–57 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

The phase equilibrium and certain properties of the alloys of the Ti_3Al-Zr section of the ternary system Ti-Al-Zr were studied. The section studied and the compositions of the investigated alloys are shown on a concentration triangle of a portion of the Ti-Al-Zr system. The preparation methods are given, and include annealing and quenching conditions. Thermal, microstructural, and X-ray analysis were performed. The temperature at the start of the fusion was determined; and the dependence of the density, hardness, microhardness, and electrical resistance on the composition of the alloys was studied by commonly used techniques. C.T.C.

N66-10283* National Aeronautics and Space Administration, Washington, D. C.
STUDY OF THE PHASE STRUCTURE OF THE ALLOYS OF THE SYSTEM Ti-Al-Zr ALONG THE SECTION Ti_3Al-Zr
I. I. Kornilov and N. G. Boriskina *In its* Phys. Met. of Titanium Nov. 1965 p 58–66 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

A study is presented of the alloys of the Ti_2Al-Zr section of the Ti-Al-Zr system. A table of the electrical resistivity, and density versus composition of the alloys is given. The methods of preparation and heat treatment are included. The alloys were studied by microstructural, X-ray, and thermal analyses. In addition, the electrical resistivity and macro- and microhardness of the alloys were measured. Alloys in the cast state and after quenching (in ice water) from 1100° C, 800° C, and 500° C were subjected to the microstructural analysis. C.T.C.

N66-10284* National Aeronautics and Space Administration, Washington, D. C.
RELATIONSHIP OF STRUCTURES FORMED ON QUENCHING TITANIUM ALLOYS TO EQUILIBRIUM PHASE DIAGRAMS
B. A. Kolachev and V. A. Livano *In its* Phys. Met. of Titanium Nov. 1965 p 67–71 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Schematic metastable phase composition diagrams are plotted on the basis of the equilibrium phase diagrams of titanium alloys, with transition elements and transformations occurring in these alloys during quenching. It is shown that the diagrams are in satisfactory agreement with the published experimentally plotted diagrams, and that they permit an accurate interpretation of the experimental data. C.T.C.

N66-10285* National Aeronautics and Space Administration, Washington, D. C.
STABILITY OF β ALLOYS OF THE SYSTEM Ti-Mo-Cr-Fe-Al
N. V. Ageyev, S. G. Glazunov, L. A. Petrova, G. N. Tarasenko, and L. P. Grankova *In its* Phys. Met. of Titanium Nov. 1965 p 72–89 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

A study was made to determine what effect the addition of alloying elements had on the stability and various other properties of the Ti-Mo-Fe-Cr-Al system alloys. Also considered is the decomposition and stability on heating of the metastable β phase. Metallographic and X-ray methods were used for the analyses, and the mechanical properties obtained are given in tabular form. Among the conclusions reached are that all the investigated alloys except one are stable for 100 hours at 200° C. In alloys containing two and five percent Mo, the stability of the properties is independent of the ratio of chromium to iron. For alloys containing three to five percent Mo, not more than five percent Fe should be used, since a higher iron content has an adverse effect on the stability of the properties. In alloys containing up to five percent Cr and up to five percent Fe, not more than five percent Mo should be used. C.T.C.

N66-10286* National Aeronautics and Space Administration, Washington, D. C.
METASTABLE POLYMORPHISM OF ALLOYS BASED ON ELEMENTS OF GROUP IV OF THE PERIODIC SYSTEM
N. F Lashko *In its* Phys. Met. of Titanium Nov. 1965 p 90–98 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Metastable polymorphic transformations are considered in alloys based on group IV elements of the periodic system during quenching from temperatures of the β region. An equation is written for the conditions of the transformations, and results in two tentative conclusions: the metastable polymorphic transformations should occur with a decreasing concentration of the alloying element, increasing number of the group of the periodic system, and an increasing number of outer electrons; and the transformation in alloys containing alloying elements of one group of the periodic system should occur at the same electron concentration. Among the data included are tables on: (1) conditions of fixation of the metastable β phase during quenching of titanium alloys; (2) conditions of fixation of the metastable phase during quenching of titanium alloys forming a continuous series of β solid solutions and a limited series of α solid solutions; and (3) conditions of formation of the metastable ω phase in zirconium alloys with a eutectoid transformation. C.T.C.

N66-10287* National Aeronautics and Space Administration, Washington, D. C.
DILATOMETRIC STUDY OF TRANSFORMATIONS IN TITANIUM ALLOYS
L. P. Luzhnikov, V. M. Novikova, and A. P. Mareyev *In its* Phys. Met. of Titanium Nov. 1965 p 99–109 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

A study was made of the transformations associated with the heat treatment of industrial titanium alloys; and also alloys of the Ti-Cr, Ti-Mo, Ti-Al-Cr, and Ti-Al-Mo systems by dilatometric and other methods. These alloys in the quenched state do not show any appreciable dilatometric effects during heating. An exception is the alloy VT3-1 (5% Al, 1.7% Cr, 2% Mo), which has a negative effect in the temperature range of 286° C to 400° C after quenching from the two phase region (845° C). The dilatometric characteristics of a series of binary and ternary (with aluminum) alloys were studied. The dilatometric investigation, the study of aging, and the use of the end-quench method make it possible to assert that after quenching of the alloy VT3-1 from 845° C, a β solid solution of supercritical concentration is fixed together with the α phase. The ω phase is formed as a result of the aging (particularly in the range of 350° C to 500° C). The amount of the fixed β phase can apparently reach 30 to 40 percent. C.T.C.

N66-10288* National Aeronautics and Space Administration, Washington, D. C.
DISLOCATION THEORY OF THE HYDROGEN BRITTLENESS OF TITANIUM ALLOYS
B. A. Kolachev, V. A. Livanov, and A. A. Bukhanova *In its* Phys. Met. of Titanium Nov. 1965 p 110–119 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

A dislocation theory of hydrogen brittleness developing at low deformation rates is proposed, based on the assumption that on the dislocations, hydrogen forms Cottrell atmospheres which are entrained by the dislocations over a certain temperature range. The dislocations transport the hydrogen toward the grain boundaries, causing the appearance of hydrogen segregations which facilitate the generation and propagation of cracks. This theory makes it possible to account for the basic regularities involved in the hydrogen brittleness of $\alpha + \beta$ alloys: (1) increase in their tendency toward hydrogen brittleness with an increase in hydrogen content, decrease in temperature, and decrease in the deformation rate, (2) intercrystalline character of the failure, and (3) increase in the temperature of the transition from viscous failure to brittle failure with increasing hydrogen content. It is shown that the relationships predicted by the theory are in satisfactory agreement with the experimental data for the titanium alloy 140A (2% Fe, 2% Cr, 2% Mo). C.T.C.

N66-10289* National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF ALLOYING ON THE PHYSICOCHEMICAL PROPERTIES OF TITANIUM
S. F. Kovtun and R. A. Ul'yanov *In its* Phys. Met. of Titanium Nov. 1965 p 120–136 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

A study was made to determine what effect the addition of alloying elements had on the variation in the electrical resistivity, the coefficient of linear expansion, and the oxidizability of titanium. The alloying elements used were aluminum, chromium, molybdenum, rhenium, tantalum, iridium, palladium, beryllium, and lanthanum. When titanium is alloyed in the region of solid solutions, the change in hardness and electrical resistivity at temperatures from −196° C to the temperatures of phase transformations is determined by the relative atomic diameters and chemical nature of the alloying elements. As the temperature is raised, the temperature coefficient of the electrical resistivity of titanium and its alloys increases in magnitude while remaining positive. At thermal cycles encompassing the region of phase transformations, an irreversible change in shape takes place. Chromium, tantalum, and lanthanum markedly increase the oxidation rate of titanium at 800° C, but palladium and rhenium have a favorable effect at this temperature. C.T.C.

N66-10290* National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF THE CHARACTERISTICS OF THE INTERDIFFUSION OF TITANIUM AND MOLYBDENUM FROM THE ATTENUATION OF γ RADIATION
A. Ya. Shinyayev, V. O. Akopyan, L. F. Sokiryanskiy, and I. V. Bogolyubova *In its* Phys. Met. of Titanium Nov. 1965 p 137–145 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

A new method was used to determine the concentration of titanium and molybdenum in the diffusion zone, based on the principle of attenuation of the intensity of a narrow beam (10–15μ wide) of gamma radiation passing through various microsections of the zone. A system of equations is given, and used to obtain one equation for determining the titanium concentration as a function of the intensity of the radiation passing through each segment of the specimen. Among the data included are graphs of: (1) distribution of the concentration of the component and the diffusion zone, (2) distribution of the concentration of the components in the probability grid, and (3) coefficient of interdiffusion versus concentration of components for the titanium region. Also included is a tabulation of diffusion characteristics under various annealing conditions. C.T.C.

N66-10291* National Aeronautics and Space Administration, Washington, D. C.
ON THE REDISTRIBUTION OF IMPURITIES IN TITANIUM AND ITS ALLOYS DURING OXIDATION
N. V. Korolev, S. A. Gorbunov, A. S. Bogdanov, and G. P. Nadutenko *In its* Phys. Met. of Titanium Nov. 1965 p 146–154 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

An examination was made of the problems of the redistribution of carbon, nitrogen, iron, aluminum, silicon, calcium, and magnesium between the surface layers of the bulk of titanium specimens after heating in air at 800° C to 1200° C. Spectral analyses and microhardness measurements were made, and established that the gas-saturated layer-on specimens of titanium oxidized in air at 1100° C to 1200° C consists of an interstitial solid solution of oxygen, carbon (up to 1.0%), and nitrogen (up to 3.0%); in addition, the surface layer becomes saturated to some extent with iron, chromium, and aluminum. The study shows that at 1100° C to 1200° C the increase in the content of nitrogen in the surface layers is due mainly to a reaction of titanium with nitrogen in the air. It is established that the gas-saturated layer becomes enriched with the alloying elements following oxidation in air of the following binary alloys: Ti-Mo, Ti-V, Ti-Cr, Ti-Mn, Ti-Sn, and Ti-Cu. C.T.C.

N66-10292* National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF OXYGEN ON THE MECHANICAL PROPERTIES OF HEAT-TREATED ALLOYS AT_3 AND AT8
B. K. Vul'f and S. A. Yudina *In its* Phys. Met. of Titanium Nov. 1965 p 155–160 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

An investigation was made of the effect of oxygen content on the mechanical properties of heat treated AT type alloys belonging to the Ti-Al-Mo system. These alloys have the lowest (AT_3) and highest (AT8) aluminum content. It was found that a rise in oxygen content in the alloys from 0.10% to 0.4% increases their strength but decreases their plasticity. It was also found that alloy AT_3 is less sensitive to a change in the mechanical properties than alloy AT8 when the oxygen content rises. In the case of alloy AT_3, as the oxygen content rises, there is an abrupt decrease in impact strength, whereas in the case of alloy AT8, the most sensitive characteristic in this respect is the transverse contraction. C.T.C.

N66-10293* National Aeronautics and Space Administration, Washington, D. C.
CHARACTERISTICS OF THE OXIDATION OF CERTAIN TITANIUM ALLOYS DURING HEATING PRIOR TO PLASTIC DEFORMATION
I. M. Pavlov, A. Ye. Shelest, and Ye. G. Konstantinov *In its* Phys. Met. of Titanium Nov. 1965 p 161–165 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Study results are presented of the oxidation kinetics of certain titanium alloys. In the method used for this investigation, specimens were removed from the furnace in batches after a predetermined heating time had elapsed in order to weigh intermediate samples. After heating the specimens were inspected; and the color, macrostructure, thickness, and strength of the scale were thoroughly described. All the quantities characterizing the oxidation kinetics were found directly by weighing or by simple calculations. The kinetic oxidation curves of the alloys are examined, and show that the oxidation follows a parabolic law during the first stage, which, as the duration of the oxidation increases, changes into a linear law. The experiments confirmed the hypothesis that the oxidation rate is governed by the concentration gradient of oxygen in the surface layers

of the metal. The reaction of formation of titanium oxides takes place at first at the metal scale phase boundary, and then shifts to the boundary between the solid and gaseous phase. C.T.C.

N66-10294* National Aeronautics and Space Administration, Washington, D. C.

NITRIDING OF TITANIUM ALLOYS AT HIGH PRESSURES

Ye. N. Novikova *In its* Phys. Met. of Titanium Nov. 1965 p 66–174 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

An investigation was conducted to determine methods in nitriding processes to increase the depth of the layer, and to eliminate the brittle nitride zone which hinders the penetration of nitrogen into titanium. The methods used are given, and the conditions and results of nitriding several alloys are tabulated. During this nitriding, a decrease of the pressure in the chamber from 760 mm to 0.1 mm Hg leads to a 1.5- to 2.0-fold increase in the depth of the nitrided layer, while the thickness of the brittle nitride zone is reduced several fold. It was established that for each titanium alloy at the same temperature and nitriding time, there should exist certain pressures and a certain nitrogen consumption at which a maximum depth of the layer can be obtained. The layer obtained in rarefied nitrogen resists wear satisfactorily, and its wear resistance is as high as that of the layer obtained by nitriding at normal pressure. C.T.C.

N66-10295* National Aeronautics and Space Administration, Washington, D. C.

CORROSION OF TITANIUM ALLOYS OF SERIES VT AND AT IN SOLUTIONS OF SULFURIC ACID CONTAINING NICKEL SULFATE

S. A. Nikolayeva and V. A. Zinov'yev *In its* Phys. Met. of Titanium Nov. 1965 p 175–180 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

A study was made to determine the influence of nickel and copper sulfate additions on the corrosion properties of titanium in sulfuric acid. Also investigated was the corrosion behavior of titanium alloys of series VT and AT. The corrosion resistance of sheet, rod, and forged titanium was determined. The obtained corrosion rates for the VT and AT alloys are tabulated, and conclusions are reached from this table. Various curves representing the corrosion rate versus sulfuric acid concentration in the presence and absence of nickel sulfate were examined, and the conclusions are given. A series of experiments devoted to the study of the influence of copper sulfate additions are included. C.T.C.

N66-10296* National Aeronautics and Space Administration, Washington, D. C.

CHEMICAL STABILITY OF TITANIUM IN CERTAIN AGGRESSIVE MEDIA AND SCOPE OF ITS USE IN CHEMICAL INDUSTRIAL EQUIPMENT

S. M. Babitskaya, V. A. Strunkin, T. P. Zal'tsman, and Yu. I. Sorokin *In its* Phys. Met. of Titanium Nov. 1965 p 181–187 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Study results are presented for the effect of chlorine on the corrosion of titanium in sulfuric acid; the chemical stability of titanium in organic acids; and new areas of application of titanium in industrial chemical apparatus. A graph is given for the effect of chlorine on the corrosion of titanium by sulfuric acid, and various conclusions are derived from this graph. Corrosion properties of titanium in organic acids are tabulated, and include concentration; duration of tests; and corrosion rate in liquid, vapor, and at the interface. New prospects are included for the use of titanium equipment in processes involving hydrochloric, hydrobromic, hydriodic, and sulfuric acid containing free halogens. It is concluded that titanium is distinguished by a good chemical stability in a series of organic acids. In addition, it is noted that in a mixture of glacial acetic acid; acetic anhydride; and in tartaric, formic, and particularly acetic acid, titanium is strongly attacked. It is also concluded that free chlorine substantially inhibits titanium corrosion. C.T.C.

N66-10297* National Aeronautics and Space Administration, Washington, D. C.

CHEMICAL STABILITY OF TITANIUM IN HYDROHALIC ACIDS AND HALOGENS

Kh. L. Tseytlin, L. L. Fayngol'd, and V. A. Strunkin *In its* Phys. Met. of Titanium Nov. 1965 p 188–201 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

A study was conducted to determine the effect of halogens on the corrosion of titanium by hydrohalic acids; the chemical stability of titanium toward chlorine, bromine, and iodine; and the effect of aromatic nitro compounds on the corrosion of titanium by hydrochloric acid. It was found that free halogens markedly inhibit the corrosion of titanium by hydrochloric, hydrobromic, and hydriodic acid. Also, titanium ignites at room temperature in dry gaseous chlorine (from a cylinder) in 24 hours, in liquid bromine in 10 min, and in dry crystalline iodine at 100° C in 15 min. Water inhibits the reaction of titanium with liquid bromine, but does not exclude a strong localized attack. The use of titanium equipment was found to be inadmissible in cases where the separation of bromine as a separate phase is possible. A tabulation of the effect of aromatic nitro compounds on the rate of titanium corrosion is included. C.T.C.

N66-10298* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF SODIUM NITRATE ON THE CORROSION OF TITANIUM BY HYDROCHLORIC AND SULFURIC ACID

Ya. I. Sorokin and Kh. L. Tseytlin *In its* Phys. Met. of Titanium Nov. 1965 p 202–210 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

A study was conducted to determine the influence of sodium nitrite on the corrosion of titanium by hydrochloric and sulfuric acid. The experimental methods are given, and graphs showing corrosion rates versus testing times are included. It was found that titanium VT1-1 displays a satisfactory stability in 20 percent hydrochloric and sulfuric acid at temperatures up to 10° C, and corrodes substantially at temperatures above 20° C. Additions of certain sodium nitrite concentrations to hydrochloric and sulfuric acid impart a positive electrode potential sufficient for chemical passivation to the surface of titanium. Sodium nitrite markedly decreases the corrosion of titanium by acids only under certain testing conditions. In order to provide for a satisfactory stability in 20 percent hydrochloric and sulfuric acid, it is necessary to add 0.01 percent $NaNO_2$ at 20° C and 0.1 percent $NaNO_2$ at 60° C. C.T.C.

N66-10299* National Aeronautics and Space Administration, Washington, D. C.

STUDY OF THE USE OF TITANIUM ALLOYS IN THE CONSTRUCTION OF FOOD MACHINES

F. N. Tavadze and T. A. Lashkhi *In its* Phys. Met. of Titanium Nov. 1965 p 211–222 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Establishing the possibility of the application of titanium alloys of the ATn series to the construction of food machinery was considered. Tests were conducted in a series of organic acids and technological solutions K1 and V1 corresponding to aggressive media employed in the canning and wine-making industry at room and boiling temperature, and also in natural

cherry plum juice. The results of corrosion tests of the weld joints of alloys AT3 and AT8 in various acids were shown. It was evident that on the corrosion resistance scale, the alloys were in the region of corrosion resistant values, as in the case of oxalic and tartaric acid. In oleic, tartaric, acetic and lactic acid the corrosion of the alloys was equal to zero. It was noted that the chemical analysis of the reaction medium established that during the corrosion of titanium alloys at room temperature, no transfer of titanium ions into the medium took place. R.W.H.

N66-10300* National Aeronautics and Space Administration, Washington, D. C.
STRENGTH OF INTERATOMIC BONDING OF SINGLE-PHASE ALLOYS IN THE SYSTEM Ti–Nb–Cr
K. I. Shakhova and P. B. Budberg *In its* Phys. Met. of Titanium Nov. 1965 p 223–230 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

An estimate of the interatomic bond in single-phase alloys of a ternary system was made. The elastic constants of β and γ alloys were determined by an electronic method with an elastomat unit which made it possible to obtain the elastic characteristics within 1–1.5%. The specimens used were cylindrical rods 80 to 100 mm long and 6 to 8 mm in diameter, melted in an arc furnace and cast in a vacuum. In alloys of all the sections with a content of 50 percent Cr in which the γ phase was predominant, the modulus of normal elasticity attained values of (16 to 21) $\times 10^3$ kg/mm^2. It was shown that the modulus of normal elasticity of solid solutions of metallic compounds was considerably higher than that of the solid solutions of the pure components of the β phase. The results obtained confirmed the conclusion reached earlier from the analysis of the root-mean-square displacements of the atoms at 0 and 293° K concerning the greater interatomic bonding strength of solid solutions of metallic compounds and their lesser softening tendency with rising temperature. R.W.H.

N66-10301* National Aeronautics and Space Administration, Washington, D. C.
STUDY OF THE CREEP OF ALLOYS IN THE SYSTEM Ti–V–Nb–Mo
I. I. Kornilov, O. K. Belousov, and V. S. Mikheyev *In its* Phys. Met. of Titanium Nov. 1965 p 231–238 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

One of the lines of investigation in the study of the problems of high temperature strength was the analysis of the dependence of creep and stress rupture strength on the character of the chemical interaction between metals and other elements of the periodic system, on the equilibrium factors in the systems, the phase and structural state, and crystal-chemical reactions. A study of the high temperature strength of this system was conducted by the centrifugal method, and tested in three stages. On the basis of the data obtained by studying the creep of alloys of the quaternary system, composition high temperature strength diagrams were plotted indicating the dependence of the time necessary for reaching a given bending deflection of 3, 5, and 10 mm of the composition under certain given conditions. The data given for the dependence of the high temperature strength on the composition and phase structure made it possible to conclude that all of the alloys of the α regions of the quaternary system Ti–V–Nb–Mo soften rapidly at 500° and $\sigma = 15$ kc/mm^2 and were not used as heat resistant alloys for long periods of operation under the selected conditions. R.W.H.

N66-10302* National Aeronautics and Space Administration, Washington, D. C.
CHARACTERISTICS OF THE COLD BRITTLENESS OF TITANIUM
B. B. Chechulin and M. B. Bodunova *In its* Phys. Met. of Titanium Nov. 1965 p 239–248 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Certain features of the transformation of technically pure titanium into a cold short state are discussed; and the dependence of the appearance of brittleness in titanium on various external factors such as the extent of stress condition, deformation rate, and size of specimens are analyzed. Titanium ingots were melted in a vacuum arc furnace, and the hydrogen content of the specimens was raised in steps from 0.002 wt% to 0.66 wt%. The temperature threshold of brittleness was determined. Chemical composition data of the specimens, and other experimental characteristic data are tabulated, and are also depicted graphically. It was shown that the principal cause of cold brittleness of titanium is explained by the presence of hydrogen. Cold brittleness is not displayed by titanium free from hydrogen. It is indicated that the principal cause of cold brittleness of metals in general may be the presence of impurities which are bound to be present in metals of technical purity. L.S.

N66-10303* National Aeronautics and Space Administration, Washington, D. C.
CREEP OF ALLOY AT3 AT 350°
K. P. Markovich, V. S. Mikheyev, and Z. G. Fridman *In its* Phys. Met. of Titanium Nov. 1965 p 249–254 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

The creep of titanium base alloy AT3 of the six component system Ti–Al–Cr–Fe–Si–B with 3% Al and 1.26% Σ (Cr, Fe, Si) at 350° C was investigated. The tests for creep stresses of 15, 30, 33, and 37 kg/mm^2 lasted 5000 hrs, and the tests for creep stresses of 45 and 50 kg/mm^2 were run for 9300 to 12 000 hrs. It was found that the creep rate of the alloy does not exceed 2×10^{-5} %/hr for a 37 kg/mm^2 creep stress. An increase in creep rate was observed at stresses of 45 and 50 kg/mm^2 and are respectively equal to 0.5×10^{-4} %/hr and 1.6×10^{-4} %/hr at the steady-state creep stage. The limiting stress at 350° C at which the residual deformation after 20 000 hrs of tests corresponds to 1% is equal to 42 kg/mm^2. L.S.

N66-10304* National Aeronautics and Space Administration, Washington, D. C.
STUDY OF THE CREEP AND THERMAL STABILITY OF ALLOY AT4 AT 500°
I. I. Kornilov, O. N. Andreyev, and B. M. Voshedchenko *In its* Phys. Met. of Titanium Nov. 1965 p 255–260 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Creep and thermal stability tests of titanium alloy AT4 of the six component system Ti–Al–Cr–Fe–Si–B were investigated at 500° C. The alloy was melted in a vacuum arc furnace by double remelting, and the tests lasted for 1000 hrs. The chemical composition of AT4 (titanium base) is 4.67% Al, 0.86% Cr, 0.31% Fe, 0.27% Si, and 0.001% B. The content of impurities is 0.05% C, 0.024% N_2, and 0.007% H_2. The experimental data are depicted graphically and compared against similar curves for other titanium base alloys. It is seen that the creep in alloy AT4 is considerably lower than in alloys OT4, OT4-2 of the system Ti–Al–Mn, alloy VT5-1 of the system Ti–Al–Sn, and alloy VT6 of the system Ti–Al–V. The residual elongation of AT4 after 1000 hrs of testing at stresses of 2.5 and 5 kg/mm^2 is respectively 0.18% and 0.5%. The limiting stress causing a creep rate of 0.3×10^{-6} %/hr at 500° is 2.5 kg/mm^2 indicating a high creep resistance of alloy AT4 under the given conditions. L.S.

N66-10305* National Aeronautics and Space Administration, Washington, D. C.

DETERMINATION OF THE RELAXATION RESISTANCE OF ALLOY AT3

L. P. Nikitina *In its* Phys. Met. of Titanium Nov. 1965 p 261–268 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Relaxation tests were run on ring specimens of titanium base alloy AT3 in the temperature range of 350° to 650° C (every 50° C) for determining the stress relaxation of the alloy. The stress levels selected for the tests were 0.375, 0.50, and $0.75\sigma^{+}_{0.2}$. The experimental data are depicted graphically with respect to temperature and time dependence. The results are in complete agreement with the general concepts of relaxation and creep data for metals of a similar nature, and the relationships for AT3 established by the data should be useful in similar studies on these metals. L.S.

N66-10306* National Aeronautics and Space Administration, Washington, D. C.

CREEP OF ALLOYS OF THE QUATERNARY SYSTEM TI-ZR-AL-SN AT 750°

I. I. Kornilov, T. T. Nartova, and M. M. Savel'yeva *In its* Phys. Met. of Titanium Nov. 1965 p 269–275 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Alloys of the quaternary system Ti–Zr–Al–Sn along the section extending from pure zirconium to alloy compositions corresponding to the quasi-ternary system Ti_3Al–Zr–Ti_3Sn were tested by the centrifugal bending method in order to determine the creep resistance of the alloys as a function of composition, phase structure, and temperature. A diagram of the quasi-ternary section within the quaternary system is presented. The alloys were prepared for the bending tests by arc melting. On the basis of data obtained, various plots were made of creep; and diagrams of composition vs time curves necessary to reach a given bending deflection for the alloys were studied. Experiments were also performed in which additional alloying metals such as vanadium, niobium, and molybdenum were added for the purpose of increasing the knowledge of the technological plasticity of the alloy system. The results show that these additions raise the high temperature resistance of the quaternary solid solution based on the compound Ti_3Al, and that molybdenum and niobium do so to a much greater extent than does vanadium. L.S.

N66-10307* National Aeronautics and Space Administration, Washington, D. C.

STUDY OF THE MECHANICAL PROPERTIES OF TITANIUM ALLOYS AT3, AT4, AT6 AND AT8 IN RELATION TO THE TESTING TEMPERATURE

V. S. Mikheyev *In its* Phys. Met. of Titanium Nov. 1965 p 276–282 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

The mechanical properties of melts of titanium base alloys AT3, AT4, AT6, and AT8 were studied at testing temperatures from 20° to 1000° C. The composition of each alloy includes chromium, iron, silicon, and boron varying in total amounts from 1% to 1.6%; but the distinguishing difference between them is the aluminum composition, AT3 containing 3%, AT4 having 4.5%, AT6 containing 6%, and AT8 having 7.5%. The experimental data are plotted, along with other curves representing the change in the mechanical characteristics of iodide and magnesiothermic titanium. It is seen that as the aluminum content of the six component system increases from 3% to 8%, the total content of chromium, iron, silicon, and boron being constant, the ultimate strength of the alloy increases. Alloy AT3 has an ultimate strength of up to 80 kg/mm^2, and alloy AT8 goes up to 124 kg/mm^2. As the testing temperature is raised, the ultimate strength of titanium and the titanium base alloys decreases, and does so most rapidly above 450° C. L.S.

N66-10308* National Aeronautics and Space Administration, Washington, D. C.

HIGH-TEMPERATURE STRENGTH OF ALLOYS OF THE QUATERNARY SYSTEM Ti–Al–Mo–V

Ye. N. Pylayeva and Ko Chih-Ming *In its* Phys. Met. of Titanium Nov. 1965 p 283–289 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

The dependence of the high temperature strength of the systems Ti–Al–Mo and Ti–Al–(Mo:V = 1:1) on their composition and structure was investigated. The position of these systems in the tetrahedron of the quaternary system Ti–Al–Mo–V is shown schematically. Long-time hardness and centrifugal bending-test methods were used for the study, and graphic presentations of the data are given. Of the alloys studied, the most heat-resistant ones were from the region of the quaternary γ solid solutions based on the compound TiAl. The large high temperature strength of TiAl is due to the stability of its chemical bonding. It was found that the dependence of the high temperature strength on alloy composition and structure for the system Ti–Al–(Mo:V = 1:1) obeys the relationships established for alloys of the system Ti–Al–Mo. Thus a maximum high temperature strength characterizes quaternary titanium alloys whose compositions are located in the vicinity of the boundary of transition from α solid solutions into the region of $\alpha + \beta$ phases. Other results are also discussed. L.S.

N66-10309* National Aeronautics and Space Administration, Washington, D. C.

THERMAL STABILITY OF ALLOYS AT3 AT TEMPERATURES OF 350 AND 400°

K. P. Markovich and V. S. Mikheyev *In its* Phys. Met. of Titanium Nov. 1965 p 290–296 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Aging studies were conducted on two melts of titanium base alloy AT3 having the same content of aluminum and boron, but different contents of the sum of alloying elements Σ(Cr, Fe, and Si), in order to investigate the possibility of using alloy AT3 in units operating for extended periods of time at temperatures of 350° to 400° C. Changes of the mechanical properties of the alloys during the 10000 hr aging at 350° to 400° C are shown graphically. The curves show that the strength of the alloys during aging did not change appreciably. Photographs of the microstructure of alloy AT3 established that the alloy after forging has the structure of an α solid solution with a small amount of residual β phase independent of the total content of chromium, iron, and silicon. Photomicrographs also showed that the structure undergoes little change in the course of aging under the heated conditions. L.S.

N66-10310* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF CONDITIONS OF PLASTIC DEFORMATION AND SUBSEQUENT TREATMENT ON THE PROPERTIES OF CERTAIN TITANIUM ALLOYS

I. M. Pavlov, Yu. F. Tarasevich, and A. Ye. Shelest *In its* Phys. Met. of Titanium Nov. 1965 p 297–303 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

The influence of the magnitude of plastic deformation and subsequent cooling at various rates on the mechanical properties of certain $\alpha + \beta$ titanium alloys was studied. Specimens of the alloys were rolled at 0.5 m/sec on a roll mill with reductions in area of 20%, 40%, and 60% over a temperature range of 1100° to 500° C. For each experimental point, three specimens were rolled of which one was cooled in water, the second in asbestos, and the third in air. The cooling rate of the specimens in the cooling media was measured by means of thermocouples located on the surface and at the center of the

specimens; and mechanical characteristics such as hardness, proportional limit, yield strength, ultimate strength, relative contraction of cross-sectional area, and elongation per unit length were determined. The results of the tests are presented, along with graphs depicting the dependence of hardness on the rolling temperature, reduction in area, and cooling conditions of the tested alloys. L.S.

N66-10311* National Aeronautics and Space Administration, Washington, D. C.
SOME STUDIES OF THE STRUCTURE AND PROPERTIES OF ALLOY VT5-1 DURING HEATING FOR STAMPING
Ya. M. Dityatkovskiy, N. M. Pul'tsin, V. B. Pokrovskaya, and V. A. Vinogradov *In its* Phys. Met. of Titanium Nov. 1965 p 305–310 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Weight increases of round titanium specimens cut from a hot worked rod, were determined. The increase in the weight of the blank can be used as a measure of the loss of metal during the hot working process. The tabulated data indicate that the magnitude of the weight increase increases substantially as the heating temperature of the blanks is raised. Analysis of the data shows that in the heating of titanium alloy VT5-1 for forging and stamping, a temperature above 1100° C should not be used because the metal lost in the scale and in the eliminated saturated layer is appreciably increased. Heating of VT5-1 in an atmosphere of air at various temperatures is accompanied by the formation of an altered layer whose thickness, microhardness, and structure depend on the soaking temperature. The maximum microhardness of the changed layer is observed in the surface and its value is higher with higher temperatures. Other observations are also noted. L.S.

N66-10312* National Aeronautics and Space Administration, Washington, D. C.
SOME CHARACTERISTICS OF THE HEAT TREATMENT OF ALLOY AT3 WITH A LOW CONTENT OF ALLOYING ELEMENTS
S. A. Yudina and B. K. Vul'f *In its* Phys. Met. of Titanium Nov. 1965 p 311–317 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

The influence of heat treatment on the structure, properties, and thermal stability of titanium alloy AT3 is investigated. This alloy contains the smallest amount of aluminum in the series of alloys tested, and also has a low content of alloying elements. It is particularly interesting as a material for the production of cold rolled pipes. The chemical composition of the alloying ingredients are 2.5% Al, 0.9% (Cr + Fe + Si + B), 0.013% H_2, 0.013% N_2, and 0.06% C. The alloy acquires the best mechanical properties from quenching in air over the range 825° to 850° C. The alloy quenched under these conditions has a high thermal stability and has the following mechanical characteristics after aging for 100 hr at 400° F: σ_b = 72 kg/mm^2, $\sigma_{0.2}$ = 64 kg/mm^2, σ = 18%, and Ψ = 52%, a_n = 8kgm/cm^2. L.S.

N66-10313* National Aeronautics and Space Administration, Washington, D. C.
USE OF OPTICAL EMISSION MICROANALYSIS IN THE STUDY OF TITANIUM ALLOYS
N. V. Korolev, S. A. Gorbunov, and A. S. Bogdanov *In its* Phys. Met. of Titanium Nov. 1965 p 321–331 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

The use of a modified device for optical emission microanalysis of titanium alloys is discussed. A series of examples indicating various means and methods of microspectral analysis for oxygen, nitrogen, and carbon is presented. A schematic diagram and a description of the device is given, particularly of the microspark generator. The microspectral analysis of gaseous impurities in the oxidation of technically pure titanium VT1 were investigated microspectrally, and tabulated data on the percentage content of nitrogen and carbon in surface layers of specimens of titanium alloy VT1 are given. Also studied was the effect of oxygen impurities on the strength characteristics of alloy VT15. Work is also reported for microspectral analysis with localization of charges by means of a directing groove, and for microspectral analysis in combination with selected etching of microstructure. L.S.

N66-10314* National Aeronautics and Space Administration, Washington, D. C.
DEFECT INCLUSIONS IN TITANIUM INGOTS
E. S. Fal'kevich, Ye. A. Lyukevich, and A. N. Kucherenko *In its* Phys. Met. of Titanium Nov. 1965 p 332–339 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

Ingots of technical titanium from various colored sponges were melted in a laboratory vacuum arc furnace, for determining the chemical composition of the sponges. Oxygen content was determined indirectly, and the composition data are tabulated. The purpose of the analysis is to study the nature of defect inclusions occurring in titanium ingots and semifinished products, and to study the causes of the formation of the inclusions. The data indicate that oxidized sponge titanium of yellow and bluish-violet color, dark-gray sponge, and lining film do not cause the formation of defect inclusions in ingots of technical titanium. In some cases, oxidized sponge of grayish-white color having the phase composition of rutile and titanium nitride may cause the appearance of defect inclusions in the ingots. Titanium nitride appears to be responsible for the appearance of inclusions in this case. The introduction of fragments of hard alloys measuring 2 to 12 mm into the consumable electrode caused the appearance of inclusions in the ingots in all cases. L.S.

N66-10315* National Aeronautics and Space Administration, Washington, D. C.
METASTABLE PHASES OF TITANIUM ALLOYS AND CONDITIONS OF THEIR FORMATION
S. G. Fedotov *In its* Phys. Met. of Titanium Nov. 1965 p 340–351 refs (See N66-10276 01-17) CFSTI: HC $7.00/MF $1.75

An analysis and review of the metastable phases of titanium alloys and the conditions of their formation are presented. Particularly discussed are the characteristic features of the ω phase and the polymorphic $\beta \rightarrow \alpha$ transformation. L.S.

N66-10359# Joint Publications Research Service, Washington, D. C.
STUDIES IN THE MELTING AND HOT-ROLLING OF TITANIUM AND ZONE SEGREGATION OF TITANIUM ALLOY INGOTS
29 Oct. 1965 29 p refs Transl. into ENGLISH from Tsvetn. Metal. (Moscow), no. 7, 1965 p 70–74, 76–86
(JPRS-32622; TT-65-33101) CFSTI: $2.00

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3. ZONE SEGREGATION IN TITANIUM ALLOY INGOTS V. I. Dobatkin, N. F. Anoshkin, and M. I. Musatov p 19–26 refs (See N66-10362 01-17)

N66-10360 Joint Publications Research Service, Washington, D. C.
MELTING OF SODIUM-REDUCED TITANIUM
G. M. Vsynshteyn, V. M. Bobylev, and N. A. Pampushko *In its* Studies in the Melting and Hot-Rolling of Titanium and Zone Segregation of Titanium Alloy Ingots 29 Oct. 1965 p 1-7 refs (See N66-10359 01-17) CFSTI: $2.00

The effects of electrode degassification on the melting down, and the quality of Na-reduced titanium in a vacuum arc furnace with compacted, consumable electrodes was studied. Degassed electrodes proceeded relatively smoothly and did not show the intensive metal splattering produced by undegassified electrodes. Chemical compositions and mechanical properties of ingots melted from sodium reduced titanium of 140 to 170 kg/mm^2 hardness are shown in a table; all ingots satisfied specifications with respect to impurity content as well as mechanical properties. G.G.

N66-10362 Joint Publications Research Service, Washington, D. C.
ZONE SEGREGATION IN TITANIUM ALLOY INGOTS
V. I. Dobatkin, N. F. Anoshkin, and M. I. Musatov *In its* Studies in the Melting and Hot-Rolling of Titanium and Zone Segregation of Titanium Alloy Ingots 29 Oct. 1965 p 19-26 refs (See N66-10359 01-17) CFSTI: $2.00

The uniformity of double arc-melted titanium alloy ingots was studied by either transverse or longitudinal cuttings, sampling of the chips produced by drilling of eight to 10 mm holes around the ingot diameter, and by chemical analyses. Fluctuations in aluminum content of 850 mm diameter, and of 350 mm diameter ingots were relatively low. Marked zone segregations were found in ingots with copper, nickel, molybdenum, chromium, manganese, silicon, and iron as alloying constituents. Analyses of the segregation processes showed an overall increase of the alloying constituent in the direction from the bottom towards the gate portion, and from the periphery towards the center; the intensity and direction of the segregation was clearly related to the alloy's distribution coefficient. G.G.

N66-10415*# Battelle Memorial Inst., Columbus, Ohio.
TUNGSTEN POWER METALLURGY
V. D. Barth and H. O. Mc Intire Washington, NASA, Nov. 1965 46 p refs Sponsored by NASA
(NASA-SP-5035) GPO: HC $0.35; CFSTI: MF $0.50 CSCL 13H

Developments in tungsten powder metallurgy technology as related to space vehicles are summarized. Tungsten powder production processes are briefly reviewed, and powder consolidation procedures consisting of compaction to shape in a die followed by solid state sintering are discussed. Applications of tungsten powder metallurgy to space hardware include use in infiltrated nozzle materials, high strength composites, and in the ionization section of a rocket engine. G.A.L.

N66-10428*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Equipment Labs.
THE CORROSION OF SUPERALLOYS BY LITHIUM FLUORIDE IN A CYCLIC HIGH TEMPERATURE ENVIRONMENT
Engineering Report, Jul. 1963–Jul. 1965
R. C. Schulze 21 Jun. 1965 149 p refs
(Contract NAS3-2779)
(NASA-CR-54781; TRW-ER-6561) CFSTI: HC $4.00/MF $1.00 CSCL 11F

Eleven superalloys were evaluated to determine their resistance to corrosion by lithium fluoride in a cyclic temperature environment. The tests were operated under simulated NASA Brayton Cycle system conditions (maximum lithium fluoride temperature—1850° F, minimum lithium fluoride temperature—1500° F) to determine the best material for fabrication of the heat receiver. The results of the program indicated Haynes alloy No. 25 to be the best alloy. Author

N66-10452# Du Pont de Nemours (E. I.) and Co., Aiken, S. C.
POLYGONIZATION OF VERY PURE URANIUM BETWEEN 150° AND 300°C
G. Clottes, J. C. Jousset, and J. Leteurtre Mar. 1965 4 p refs Transl. into ENGLISH from J. Nucl. Mater. (France), no. 12, 1964 p 340-344
(AEC-TR-6560)

Recrystallization of very pure uranium between 150° C and 300° C produced increased coherence of the majority of twins with increased temperatures, and led to the formation of dislocation networks. Each of those phenomena decreased the free energy of the metal. Annealing of ordinary purity uranium did not affect the recrystallization at 200° C, and beginning at 400° C, did not proceed from the above described polygonization. G.G.

N66-10505# Case Inst. of Tech., Cleveland, Ohio.
ANALYSIS OF AN INTERFERENCE TECHNIQUE FOR THIN FILM STRESS MEASUREMENT
Tatuichiro Nishiyama 1964 29 p
(Contract AT(11-1)-623)
(COO-623-102)

The iron films, 425, 509, and 525 Å in thickness were evaporated on a thin glass substrate at an angle of 36.5° by vacuum deposition at a pressure of 10^{-7} mm Hg. The intrinsic stress in the film was measured by using interference techniques. The presence of the sharp peak of the stress at a film thickness of about 700 Å was not confirmed by this experiment since the films were all less than 600 Å thick, while the thickness dependence and anisotropy of the stress were observed. It was also worth noting that the stress behavior of films deposited on the concave side of the substrate seemed to be different from that on the convex side of the same substrate. Detailed studies were carried out to estimate the accuracy of this measurement. Firstly, error due to tilt of the substrate to the observing coordinate system by the presence of dust between the substrate to be measured and an optical flat was considered. As a result of this investigation, it was estimated that the actual contribution of dust to accuracy might be negligible under usual circumstances. Secondly, an attempt was made on the statistical estimation of overall error for this measurement with the aid of the concepts of 90 percent confidence interval for population means. Author (TAB)

N66-10507# Nuclear Metals, Inc., Concord, Mass.
METALLURGICAL INVESTIGATION OF U-350Si-1000Mo AND ALLOY
A. M. White 10 May 1965 16 p refs
(Contract AT(30-1)-1565)
(NMI-7075)

Hardness behavior and microstructures were investigated for a uranium alloy containing approximately 350 ppm Si and 1000 ppm Mo. The hardness data for different conditions are compared with those for the corresponding binary alloys and for eleven alloys containing a total of at least 1000 ppm of alloying elements. The U-Si-Mo alloy exhibits solution hardening, which is lost during prolonged exposure at 500° C or 600° C. The hardness data and the metallographic observations are consistent in leading to the conclusion that the alloy is unstable. The softening during prolonged exposure is accompanied by

the precipitation and growth of particles, which are probably $U_4Mo_5Si_3$. The metallographic procedures and the electron microscope replica technique are included. C.T.C.

N66-10534# Michigan Univ., Ann Arbor. Dept. of Chemical and Metallurgical Engineering.
EFFECT OF LONG-TIME EXPOSURE ON AM350 SHEET MATERIAL Ninth Progress Report
T. M. Cullen and J. W. Freeman 1 Feb. 1965 9 p
(Contract AF 33(616)-8334)
(Rept.-04583-46-P; AD-463733)

The effects of exposure at 550° F for times up to 30 000 hours, and under stress of 67 000 psi, on the mechanical properties of AM350 sheet material were studied, together with changes in short-time tensile strength of both smooth and edge-notched specimens at room temperature, and at 550° F. The 2000, 5000, and 12 000 hr exposures of the sheet material in both the cold rolled SCT and the CRT annealed conditions have been finished, and the ultimate tensile strengths at 550° F and at room temperature, together with the elongation of unnotched specimens, were plotted as a function of exposure time at 550° F. No significant changes as the result of stressed or unstressed exposure at 550° F for both the CRT and the SCT specimens were observed during exposure up to 12 000 hours. A two percent increase in alloy strength was noted after exposure for 12 000 hours. Creep measurements of unnotched specimens during the first 25 000 hours of exposure indicate a slight contraction of up to 0.03 percent. G.G.

N66-10584# Joint Publications Research Service, Washington, D. C.
EFFECT OF HOT PLASTIC DEFORMATION ON THE STRUCTURE AND PROPERTIES OF MOLYBDENUM, NIOBIUM, AND TITANIUM
Ya. B. Gurevich and V. L. Orzhekhovskiy 8 Oct. 1965 12 p refs Transl. into ENGLISH from Metally [USSR], no. 4, Jul.–Aug. 1964 p 137–143
(JPRS-32317; TT-65-32807) CFSTI: $1.00

The effects of fabrication environment on the gas content, structure, and mechanical properties of molybdenum, niobium, and titanium are examined. It is observed that the strength and ductility characteristics of niobium and titanium depend substantially on the atmospheric conditions of the hot rolling process. These metals have lower tensile strength and yield point values and higher relative elongation and area reduction than when rolled under atmospheric conditions. Similar phenomena, observed with certain other metals, are associated with the difference in gas impurity content. E.E.B.

N66-10606*# Ling-Temco-Vought, Inc., Dallas, Tex. LTV Vought Aeronautics.
FATIGUE BEHAVIOR OF Ti-8Al-1Mo-1V SHEET IN A SIMULATED WING STRUCTURE UNDER THE ENVIRONMENT OF A SUPERSONIC TRANSPORT
John J. Peterson Washington, NASA, Nov. 1965 86 p refs
(Contract NAS1-2998)
(NASA-CR-333) CFSTI: HC $3.00/MF $0.75 CSCL 11F

This report describes a test program conducted on realistic structural assemblies, to evaluate the fatigue behavior of a candidate material for use on the supersonic transport (SST) aircraft. Tests were conducted on box-beams with tension skins simulating typical skin-stringer structures. The tension skin test specimens were fabricated from triplex annealed Ti-8Al -1Mo-1V. Tests were conducted under constant amplitude loading conditions at room temperature and at 550° F and spectrum tests were performed under conditions which simulated, as nearly as possible, the environment of the SST. A total of eight specimens were fabricated and tested during this investigation, four specimens employed spot-welds as the structural joining media and four used rivets. Author

N66-10611*# Martin Co., Denver, Colo. Aerospace Div.
DETERMINATION OF LOW-TEMPERATURE FATIGUE PROPERTIES OF STRUCTURAL METAL ALLOYS Final Report, Jul. 1964–Aug. 1965
T. F. Kiefer, R. D. Keys, and F. R. Schwartzberg Oct. 1965 156 p refs
(Contract NAS8-11300)
(NASA-CR-67818; CR-65-70) CFSTI: HC $5.00/MF $1.00 CSCL 11F

Studies were conducted to determine the low temperature fatigue properties of several stainless steel, aluminum, and nickel structural sheet alloys. Their properties were determined at 70°, −320°, and −423° F for fatigue life in the 10^3 to 10^7 cycle range. Data from a previous fatigue study are included for comparison. The compiled test results were analyzed and the materials which appear to be satisfactory for cyclic service at cryogenic temperatures include the aluminum alloys 2014-T6, 2219-T87, 2219-T62, 7039-T6, 7106-T6, 5456-H343; the stainless steel alloys 321 and A-286; and the nickel alloys Inconel 718 and Hastelloy C. R.N.A.

N66-10634*# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A STUDY OF TUNGSTEN–TECHNETIUM ALLOYS Quarterly Progress Report, Apr. 1–Jul. 1, 1965
Sep. 1965 19 p refs
(NASA Order R-48; Contract AT(45-1)-1830)
(NASA-CR-67679; BNWL-142) CFSTI: HC $1.00/MF $0.50 CSCL 11F

It is reported that the microstructure of a series of W-Tc alloys in the arc melted condition was observed. The method of preparation, and comments on the observations are given. The microhardness was determined, and the phases present were identified by X-ray diffraction. Enlargements of 50X, 250X, and 750X are included for the alloy structures. C.T.C.

N66-10668*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERIMENTAL X-RAY STRESS ANALYSIS FOR PRECIPITATION HARDENED ALUMINUM ALLOYS
James H. Wharton and William L. Prince 13 Sep. 1965 29 p refs
(NASA-TM-X-53329) CFSTI: HC $2.00/MF $0.50 CSCL 11F

X-ray diffraction techniques for determining stress in precipitation hardened aluminum alloys have been developed and evaluated. The materials investigated included 2014-T6, 2219-T37, and 7075-T6 aluminum alloys. A precision corresponding to ±5 percent of the alloy yield strengths was obtained under laboratory conditions. Further studies are needed to evaluate this method for field measurements of stress in vehicle components. Author

N66-10673*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
POTASSIUM CORROSION TEST LOOP DEVELOPMENT. MATERIAL SPECIFICATIONS FOR ADVANCED REFRACTORY ALLOYS Topical Report No. 3
D. N. Miketta and R. G. Frank 1 Oct. 1965 295 p
(Contract NAS3-2547)
(NASA-CR-54761) CFSTI: HC $6.00/MF $1.50 CSCL 11F

A forced circulation, two phase boiling and condensing potassium loop testing program is being conducted to evaluate an advanced refractory alloy containment materials and candidate turbine materials for application in space electric power systems. This report covers the preparation of materials specifications for four candidate alkali metal containment alloys and two candidate turbine alloys. The candidate containment alloys selected are FS-85 and D-43 niobium alloys, and T-111 and T-222 tantalum alloys. The candidate turbine alloys are Cb-132M niobium alloy and Mo-TZC molybdenum alloy. Tentative materials specifications were prepared for the procurement of bar and rod, sheet, plate, and strip; and seamless tubing and pipe for the containment alloys, and bar and rod for the turbine alloys. R.N.A.

N66-10678# Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center.
QUARTERLY METALLURGICAL PROGRESS REPORT NUMBER 25, OCTOBER 1–DECEMBER 31, 1964
[1964] 30 p ref
(Contract AT(11-1)-599)
(USBM-RC-1150)

Continued research conducted under related programs which were designed to: (1) evaluate the properties and potential use at high temperatures of cast specimens of high melting point metal-carbon alloys; (2) develop methods for making uniform dispersions of thoria in a thorium matrix; (3) develop a furnace for induction melting reactive metals in a water-cooled copper crucible; (4) investigate the pseudo-ternary system UC–UN–UO in connection with its usefulness in the production of high temperature nuclear reactor fuels; (5) develop techniques for the production of high quality tubing of W-25 Re alloy from arc cast ingots; and (6) determine engineering properties of the W-25 Re alloy; is reported. Sixty-one specimens of hafnium–carbon alloys were cast, and their properties and carbide casting quality were evaluated. Two techniques for coating thoria spheres with thorium, and subsequent dispersions in a thorium matrix, are reported. An invention report was filed describing appratus developed under the cold-mold induction melting program. Modifications in equipment and facilities used in studying the UCO–UO and UN–UO binary systems, are reported. Electrode arc melting and hot topping techniques which were used in the preparation of W-25 Re alloy ingots are analyzed. Research planned for an evaluation of alloys produced by both arc melting and powder metallurgy processes is outlined. S.C.W.

N66-10698# Oak Ridge National Lab., Tenn.
LABORATORY CORROSION STUDIES FOR THE HIGH FLUX ISOTOPE REACTOR
J. L. English and J. C. Griess Jun. 1965 23 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1029)

Studies conducted under a corrosion test program designed to examine the behavior of several materials considered for permanent or semipermanent installation in the High Flux Isotope Reactor (HFIR) system, are reported. Both static tests and dynamic tests were performed. Presented are results obtained in the static tests. Major emphasis was placed on the procurement of long term data, however, short term data were also obtained. Reported are experimental data on the following materials: aluminum, aluminum in contact with metallic materials, aluminum in contact with nonmetallic materials, stainless steels and related materials, plastics, and miscellaneous materials. S.C.W.

N66-10699# Oak Ridge National Lab., Tenn.
HIGH-TEMPERTURE CREEP BEHAVIOR OF TYPE 304 STAINLESS STEEL IN ARGON-OXYGEN ENVIRONMENT OF DIFFERENT OXYGEN PARTIAL PRESSURES
P. Rodriguez (M.S. Thesis—Tenn. Univ.) 5 May 1965 41 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1124)

This report describes the results of comparative creep studies on type 304 stainless steel in argon-oxygen environments of various oxygen partial pressures at 815°C and 3400 lbs/sq in. It was found that at low concentrations of oxygen the creep rate of type 304 stainless steel decreases with increasing amounts of oxygen in the environment. Above seventy parts per million, the creep rate of the material increased with increasing oxygen content, until a maximum creep rate was observed at 256 parts per million of oxygen. With further increases in oxygen content, the creep rate decreased again progressively. The influence of oxygen concentration in the environment on the creep-rupture behavior at 927°C and 2000 lbs/sq in. followed the same trend as stated above, the influence being manifested on the secondary creep rate as well as on the rupture life in the various environments. At low concentrations of oxygen surface scales were very adherent and were identified as mainly Cr_2O_3. At higher concentrations the surface film was of the spinel type and was found to be less adherent. Author

N66-10702*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. Materials Research and Development Dept.
GENERATION OF LONG TIME CREEP DATA OF REFRACTORY ALLOYS AT ELEVATED TEMPERATURES Ninth Quarterly Report, 26 Jun.–26 Sep. 1965
J. C. Sawyer 8 Oct. 1965 109 p refs
(Contract NAS3-2545)
(NASA-CR-54773) CFSTI: HC $4.00/MF $0.75 CSCL 11F

A summary is presented of creep data obtained at high temperatures for refractory alloys which have potential use in advanced power systems. Emphasis has been placed on the testing of sheet alloys which can be employed for cladding or tubing applications and on forgeable, high-strength turbine alloys. Types of materials evaluated, their chemical compositions, and their processing histories are tabulated. Results are given for molybdenum, niobium, tantalum, and tungsten alloys; comparative creep properties are discussed; and thermocouple drift data are presented. M.W.R.

N66-10705# Titanium Metals Corp. of America, New York.
PROPERTIES OF Ti-6Al-4V
Feb. 1965 46 p *Its* Eng. Bull. No. 1 Revised

Physical, mechanical, and design properties are reviewed for Ti-6Al-4V which is available in sheet, strip, plate, bar, billet, wire, extruded shapes, and tubing. Fabrication characteristics for the alloy are discussed and weight tables for the various forms are included. M.W.R.

N66-10706# Hawker Siddeley Canada, Ltd., Toronto (Ontario). Engineering Div.
THE EVALUATION AND PROPERTIES OF COATINGS FOR SUPER ALLOYS AND REFRACTORY METALS
W. A. James Paris, AGARD, Jan. 1965 51 p refs Struct. and Mater. Panel of AGARD Working Paper No. M35, Issue No. 2
CFSTI: HC $2.00/MF $0.50

A survey made in NATO countries reveals that methods are relatively well defined for the determination of physical and mechanical properties of coatings for superalloys and refractory metals. Widely different methods, however, are

being used to determine resistance to corrosion, erosion, and thermal shock and fatigue, and details of many of these methods are given. Differences in evaluation procedures employed are attributed to basic differences in opinion as to what is wanted from a test. Reports dealing with properties of composites of molybdenum, niobium, tantalum, and tungsten are included, and an appendix lists the commercial, government, and other research facilities visited during the survey. M.W.R.

N66-10718# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
EVALUATION OF ZIRCALOYS FOR USE IN THE 630 A REACTOR
R. K. Betts 26 Feb. 1965 46 p refs
(Contract AT(40-1)-2847)
(GEMP-346)

Zircaloy-2 and -4 have been evaluated through a literature survey to determine their suitability for use in the 630A Mark V-A and -B cores. On the basis of existing technology, they possess essentially equivalent, adequate mechanical properties and corrosion resistance for the conditions of interest. Either alloy appears suitable for the proposed application. Author

N66-10734# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
EXAMPLES OF APPLICATIONS OF LINE BROADENING
D. E. Mikkola and J. B. Cohen 1 Jun. 1965 71 p refs Submitted for Publication
(Contract Nonr-1228(20))
(TR-4; AD-467479)

Applications of Fourier analysis described in Chapter 7 to studies of local atomic arrangements occurring in cold worked metals and metallic solid solutions are considered in the first part of this chapter. Other applications which have been made will also be discussed together with an extension of the mathematical treatment to the case of an ordered alloy of the L12 type (Cu_3Au). In conclusion, some recent experimental observations on cold worked Cu_3Au will be presented.
Author (TAB)

N66-10741# English Electric Co., Ltd., Whetstone (England). Central Metallurgical Labs.
THE EROSION OF A COBALT CHROMIUM ALLOY BY LIQUID IMPACT
J. B. Marriott and G. Rowden 28 Jun. 1965 16 p refs
(W/LAu.175) CFSTI: HC $1.00/MF $0.50

Cast cobalt chromium alloy specimens and Haynes alloy specimens were subjected to repeated impacts by a water jet to obtain data on the process of erosion in a steam turbine, and to determine the erosion resistance of possible shielding materials. After testing to 200000 impacts, a deep track of erosion damaged material was observed in the test face of the cobalt chromium alloy specimen. Metallographic examination of sections taken from this area indicated the presence of pits and cracking which resembled those observed on shields removed for service. To study the effect of water jet impact loading on the surface of the material, specimens of Haynes alloy were examined metallographically. The following stages were observed during the erosion process: slip deformation and work hardening of the specimen surface, cracking of interfaces between carbide particles and the matrix, intrusion formation at certain slip lines as a result of cyclic stressing, and material removal by the intersection of transgranular cracks.
S.C.W.

N66-10751*# Huyck Corp., Milford, Conn. Huyck Metals Dept.
PREPARATION AND EVALUATION OF FIBER METAL NICKEL BATTERY PLAQUES Final Report, Aug. 1, 1964–Jul. 31, 1965
J. L. Bidler and J. I. Fisher [1965] 80 p refs
(Contract NAS3-6006)
(NASA-CR-54777; HUYCK-805(F3-25)) CFSTI: HC $3.00/MF $0.75 CSCL 11D

Flexible fiber metal plaques can be produced with internal surface areas greater than 500 cm^2/gm, tensile strengths greater than 300 psi, porosites of 90% or greater and electrical resistivities of 400 microhm-cm or less. Although not all of the values indicated above can be achieved in the same plaque, sufficient data are presented to permit an evaluation of the effect of processing parameters upon the plaque characteristics and to indicate which fiber characteristics should be varied to optimize specific plaque properties. A new fiber type has been developed to maximize the internal surface area and porosity. It is anticipated that this material can be processed into plaques with greater than 90% porosity and with an internal surface area in excess of 800 cm^2/gm.
Author

N66-10770# Nevada Univ., Reno. Dept. of Physics.
FIELD EMISSION STUDIES OF THE SURFACE CONSTANTS OF REFRACTORY METALS Final Report
Philip C. Bettler 20 Aug. 1965 26 p refs
(Grant AF-AFOSR-62-297)
(AFOSR-65-1688; AD-620679)

The activation energy for surface migration, the surface tension, and the diffusivity constant for surface motion were measured, using field emission techniques, for tungsten (bcc) and rhenium (hcp). The values for tungsten agree well with results reported by other investigators. Similar work on rhenium was not reported previously. Investigations are continuing on other metals with face centered cubic and hexagonal close packed crystal structure. Author (TAB)

N66-10774*# Hittman Associates, Inc., Baltimore, Md.
THERMOELECTRIC BONDING STUDY Quarterly Progress Report, 1 Jun.–31 Aug. 1965
30 Sep. 1965 36 p refs
(Contract NAS5-3973)
(NASA-CR-67672; HIT-186) CFSTI: HC $2.00/MF $0.50 CSCL 09C

Progress was made in developing a reliable bond for n-PbTe. Indications from thermoelectric measurements, metallography, and life tests up to 500 hours are favorable. Torsion tests showed that bonds are of consistent reproducible strength. The lack of success with p-PbSnTe is consistent with previous results. A decision was made to resume work with p-PbTe (TEG-2P) and to concentrate on improving its properties, particularly its poor strength. R.N.A.

N66-10787# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF CORROSION RETARDATION FOR STEEL AND IRON IN ACIDS AT HIGH TEMPERATURES
R. N. Volkov, A. Ya. Shatalov, and S. A. Kononovich 26 Aug. 1965 5 p Transl. into ENGLISH from Soviet Patent No. 162739 (Appl. No. 847640/22-2, 16 Jul. 1963) 1 p
(FTD-TT-65-770/1+4; AD-621040)

The object of the invention is a method of corrosion retardation for steel and iron in acids, at high temperatures. Chloride benzyl quinoline is added as an acid inhibitor.
Author (TAB)

N66-10796# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.

INTERRELATIONSHIP BETWEEN ANISOTROPY AND CRYSTALLOGRAPHIC STRUCTURE

Robert M. Colton and Gabriel J. Enyedy Jul. 1965 12 p refs
(AMRA-TR-65-15; AD-620029)

The variations in normal and planar anisotropy in rolled metal products are shown to be functions of crystallographic structure. Each type (cubic and hexagonal) of crystallographic structure exhibits a characteristic strain ratio versus orientation curve. The average normal anisotropy parameter is linearly related to the 45 degrees strain ratio for both the cubic and hexagonal systems. Linear relationships were also found between the degree of planar anisotropy parameter and both the normal anisotropy and the strain ratio at 45 degrees in the cubic systems. No relationships were determined for the hexagonal close-packed structures although certain trends were noted.
Author (TAB)

N66-10807# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.

THE EFFECT OF SOLUTION TEMPERATURE ON MECHANICAL PROPERTIES AND MICROSTRUCTURE OF 6Al-6V-2Sn TITANIUM ALLOY

Ellsworth H. Swift, Armando A. Iannelli, and F. J. Rizzitano May 1965 12 p
(AMRA-TR-65-11; AD-620181) CFSTI: $1.00

A series of tests were conducted to determine the effect of solution temperature on the mechanical properties and microstructure of commercial-grade titanium alloy 6Al-6V-2Sn. The solution temperature was varied from 1500° F to 2200° F. the solution time, aging time, and temperature were held constant. It is concluded that optimum strength-ductility-toughness combinations are obtained at solution temperatures of 1575° F to 1600° F. Lower solution temperatures decrease the tensile and yield strengths, and higher solution temperatures show a sharp decrease in ductility and impact strength. The beta transus temperature is 1720° F. Author (TAB)

N66-10851# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STRENGTH AND DEFORMATION CHARACTERISTICS OF BINARY METAL WHISKERS

Nai-Piao Chou and Ting-Sui Ke 27 Jul. 1965 19 p refs
Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 19, no. 12, 1963 p 807–815
(FTD-TT-64-1012/1+2+3+4; AD-619467)

The tensile strength of a large number of Fe, Fe–Cu, Fe–Co, Cu and Cu–Co whiskers with diameters ranging from 20 to 300 microns has been measured at room temperature and at elevated temperatures. The results indicate that the binary metal whiskers of the dispersion type such as Fe–Cu and Cu–Co whiskers have a greater strength than single-component whiskers while the binary whiskers of the solid solution type such as Fe–Co whiskers do not. On the basis of the stress-strain curves and metallographical examination it is suggested that the high strength of the dispersion type Fe–Cu whiskers may be due to the formation of a high strength layer of the dispersive mixture of iron and copper and that their ductility may be due to the presence of the ductile copper cores in these whiskers. The basic processes involved in the thickening of the binary metal whiskers of either the dispersion or the solid solution type and their relation to the strength and deformation characteristics were discussed. It is suggested that the principle and method of growing mixed meta. whiskers of the dispersion type may serve as a useful guide in preparing high-strength composite materials with improved ductility. Author (TAB)

N66-10863# Northwestern Univ., Evanston, Ill. Technological Inst.

GRAIN ROTATION ASSOCIATED WITH THE SHOCK DEFORMATION OF METALS AND ALLOYS

R. J. De Angelis and J. B. Cohen 1 Aug. 1965 7 p refs
(Contract Nonr-1228(20))
(TR-7; AD-619498)

X-ray examination of polycrystalline copper specimens showed that there is some grain re-orientation in shock-loaded crystals despite the high strain rate and short stress application. Half-inch plates rolled and recrystallized to give an average grain size of 0.013 mm were subjected to planar shock waves of 75 to 435 kbar. Integrated X-ray peak intensities were obtained by step scanning with filtered Ni radiation while rotating the flat specimens at 100 rpm about an axis normal to the specimen surface. The data presented suggest that the compressive front is more effective in the deformation at low temperatures but that the rarefaction portion of the wave becomes more important at higher pressures. Normal compression in polycrystalline copper increases the number of {110} planes parallel to the surface, whereas tension causes {111} and {100} planes to be parallel to the surface. Single crystals shock-loaded over the same range of pressures in $< 111 >$, $< 110 >$, or $< 100 >$ directions showed no rotation in excess of about 0.2° θ.
E.E.B.

N66-10876*# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

STRESS CORROSION CRACKING OF TITANIUM ALLOYS Fourth Quarterly Progress Report, 1 Jan–31 Mar. 1965

Sheldon P. Rideout, Mc Intyre R. Louthan, Jr., and Clifford L. Selby Sep. 1965 24 p refs
(NASA Order R-124; Contract AT(07-2)-1)
(NASA-CR-67710; DP(NASA)-1005) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Research was directed toward determination of the mechanism of hot-salt cracking of Ti-8Al-1Mo-1V. Radiographic evidence showed that ^{3}H and ^{36}Cl are retained on sample surfaces, probably as HCl, after exposure to aqueous salt solutions. Adsorption of HCl appears to be a key factor in causing susceptibility to hot-salt cracking. Exposure to anhydrous HCl gas at 650° F caused abrupt mechanical rupture in stressed samples. Exposure of liquid NaOH at 650° F caused corrosion and preferential attack of aluminum, but no cracking. Aluminum is also preferentially attacked by NaCl during hot-salt cracking. Prior treatments with NaOH, which preferentially remove the aluminum from the sample surfaces, delayed the inception of stress cracking during subsequent exposures to solid NaCl or HCl gas. Results are interpreted to show that hot-salt cracking and HCl-gas cracking are similar and occur by either hydrogen embrittlement or by localized, stress-accelerated corrosion. Author

N66-10886*# West Virginia Univ., Morgantown.

ANNUAL STATUS REPORT TO NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

J. K. Stewart 1 Oct. 1965 14 p refs
(Grant NsG-533)
(NASA-CR-67721) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The purpose of this research was to evaluate the effect of ultrasonic energy in producing a dispersed phase during the metallurgical processing of alloys. Three systems which were investigated included: the effect of insonation during the solidification of cast iron on the distribution of graphite and pearlite formation, the effect of insonation on the decomposition of iron carbide in white case iron during heat treatment, and the dispersion strengthening of aluminum alloys. Ultrasonic vibrations were introduced into the alloys by means of a high purity

nickel rod attached to the transducer which operated at a frequency of 20000 cycles per second with a maximum sonic output of 75 watts. Insonation during solidification of gray cast iron produced more ferrite, less pearlite and more nodular graphite particles when compared with a non-isonated reference specimen. Author

N66-10908# RAND Corp., Santa Monica, Calif.
A SURVEY OF DEVELOPMENTS IN WHISKER COMPOSITES IN THE UNITED STATES
George A. Hoffman Apr. 1965 12 p refs
(P-3129; AD-614991)

The present effort in the United States toward developing composite materials utilizing single crystal filaments (whiskers) as reinforcement is reviewed. The survey describes first the developments in growing whiskers of various substances such as high-melting-point ceramics. Next, those projects are listed which aim at incorporating whiskers into composite test samples with a usable material as an ultimate goal. Finally, the more general designs and analyses of filamentary composites are reviewed, particularly those dealing with the problems in the micromechanics, design utilization and possible applications. Some directions in future efforts in whisker composites, as presently planned, are predicted. Author (TAB)

N66-10917# Rice Univ., Houston, Tex.
THERMODYNAMIC AND KINETIC STUDIES OF BORIDES AND OTHER REFRACTORY MATERIALS AT HIGH TEMPERATURES Technical Report, 1 Jan.–31 Dec. 1964
John L. Margrave Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1965 16 p refs
(Contract AF 33(615)-1138)
(AFML-TR-65-123; AD-472145)

The fluorination rates of elementary boron, silicon and carbon and of TiB_2 have been determined over wide ranges of temperature and fluorine partial pressures. The thermal decomposition of solid "CF" has been shown by gas chromatographic and mass spectrometric techniques to yield a variety of perfluorocarbons with up to 16 carbon atoms. High temperature heat capacities have been measured and analytical expressions representing experimental data over wide ranges of temperature have been derived for several borides, carbides, nitrides and oxides. Author (TAB)

N66-10941# European Atomic Energy Community, Brussels (Belgium).
DAMAGE AND DIFFUSION IN Al and Al-Al_2O_3 ALLOY FOLLOWING BOMBARDMENTS WITH OXYGEN OR INERT GAS
E. Ruedl and R. Kelly Aug. 1965 31 p refs Presented at the Intern. Powder Met. Conf., New York, 14–17 Jun. 1965
(EUR-2478.E) CFSTI: HC $2.00/MF $0.50

A dose and dose-rate dependence for the appearance of damage in Al and SAP is found for both O_2 and Ne bombardments at 9 kev. The damage is more aligned, however, when O_2 is used than when Ne is used. The difference in arrangement can be explained by assuming a different mobility of the loops depending on whether O_2 or Ne is present in the Al lattice. The annealing behavior of the damage also depends on which gas is used in the bombardment. In the case of O_2 the damage anneals out roughly in the temperature range for Al self-diffusion (150–200° C). In the case of Ne large loops and tangles are present even at 500° C. Moreover, Ne-bombarded specimens show at high temperatures small bubbles and large undefined features. The latter are assumed to be gas pockets or blisters near the metal/oxide-skin interface. Gas-release experiments following Kr and Xe bombardments at > 5 kev show that more than 99% of the gas is retained to the melting point. This is explained by means of depth distributions to be due to trapping near the metal/oxide-skin interface and thus confirms the observation of gas pockets or blisters. After bombardments below ~ 5 kev, gas is released beginning at the ambient temperature. Such release is analogous to that observed in other systems at low bombardment energies. Author

N66-10970# Los Alamos Scientific Lab., N. Mex.
COMPATIBILITY OF REFRACTORY METALS WITH SOLID SOLUTION (UC) (ZrC) AT ELEVATED TEMPERATURES
K. V. Davidson, R. E. Riley, and J. M. Taub 28 Sep. 1965 21 p refs
(Contract W-7405-ENG-36)
(LA-3307) CFSTI: $1.00

The results of time-temperature thermal treatments designed to investigate the compatibility of refractory metals such as tungsten, molybdenum, and niobium in the presence of solid solution (UC) (ZrC) are reported. Also given are details of the techniques used to fabricate specimens. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N66-10083 Oak Ridge National Lab., Tenn.
REPLICATION OF MICROSTRUCTURES USING SILICONE RUBBER AND EPOXY RESIN
R. S. Crouse *In* Nuclear Metals, Inc. Tech. Papers of the 17th Metallographic Group Meeting 1 Apr. 1965 p 60–68 refs (See N66-10076 01-15) CFSTI: $5.00

A method of surface replication using silicone rubber is described, which is useful in cases where progressive changes in the microstructure of a single specimen need to be preserved. The method involves the coating of a polished, etched metallographic specimen with a catalyst mixed with LTV-602. The rubber is cured, and the specimen is removed. The cavity is filled with epoxy resin and after the resin sets, the two replicas are separated, and the epoxy positive is metal coated by vacuum deposition. G.A.L.

N66-10352# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHETIC ROSIN-BASE WATERPROOF COATINGS
P. M. Fadeyev, I. G. Zhigun, and L. B. Shumakova 18 Jun. 1965 8 p Transl. into ENGLISH from Primeneniye Lakokrasochnykh Materialov (USSR), no. 3, 1962 p 50–51
(FTD-TT-65-239/1+4; AD-620075)

It was established that coatings on the basis of pure PS rosin and epoxy rosins, along with positive qualities, have much brittleness. With the addition of bitumen there is an improvement in the elasticity of the coatings, but their frost resistance and heat resistance diminish. Compositions which contain bitumen can be used for hydroinsulation of interior installations. It was shown that the optimum properties are possessed by compositions which contain the polymeric PS

rosin and epoxy rosin with the addition of plasticizers. Such coatings can be recommended for the protection of enclosing constructions which are operated under especially complicated conditions. Author (TAB)

N66-10431# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VISCO-ELASTIC-PLASTIC CONTINUUM EQUATIONS WITH COMPRESSIBILITY EFFECTS
E. Heer Jul. 1965 45 p refs
(R65SD30; AD-467940)

General rate equations for a visco-elastic-plastic material with compressibility effects are presented together with various geometrical relations in general coordinates for the development of finite difference techniques. The constitutive equations exhibit no preferred initial state and thus are suitable for an incremental finite difference development. Author

N66-10492# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF MODIFYING THE SURFACES OF FILMS OF POLYTETRAFLUOROETHYLENE AND POLYTRIFLUOROCHLOROETHYLENE
V. V. Korshak, K. K. Mozgova, and T. M. Babchinister 25 Aug. 1965 5 p Transl. into ENGLISH from Soviet Patent No. 158063 (Appl. No. 776293/23-4, 27 Apr. 1962) 1 p
(FTD-TT-65-496/1+4; AD-620792)

The object of invention is a method of modifying surface of polytetrafluoroethylene and polytrifluorochloroethylene films by grafting to them polymers of the vinyl series. For the purpose of simplifying the process, monomers with films placed in them are heated in a medium of inert gas at 60–130C for a period of 4–8 hours. Author (TAB)

N66-10525# Technische Hogeschool, Eindhoven (Netherlands).
THE MECHANICAL STRENGTH OF ALKALI-ALUMINOSILICATE GLASSES AFTER ION EXCHANGE
Anthonie Jan Burggraaf (Ph.D. Thesis) [1965] 121 p refs CFSTI: HC $4.00/MF $1.00

The factors responsible for some of the methods used to strengthen glass, and the limitations of these methods were investigated. Studies include: (1) systems; (2) experimental methods; (3) chemical attack by HF and HCl solutions; (4) the diffusion of ions in alkali-aluminosilicate glasses and a structural model; (5) the stress buildup as a result of ion exchange below the strain point, and (6) the relationship between the mechanical strength and the stress in alkali-aluminosilicate glasses after ion exchange. R.W.H.

N66-10629*# Stanford Research Inst., Menlo Park, Calif.
POLYMERS FOR SPACECRAFT HARDWARE. MATERIALS SPECIFICATIONS AND ENGINEERING INFORMATION Monthly Technical Progress Report No. 15, Aug. 10–Sep. 9, 1965
R. F. Muraca and J. S. Whittick 15 Sep. 1965 12 p Prepared for JPL
(Contracts NAS7-100; JPL-950745; SRI Proj. ASD-5046)
(NASA-CR-67692) CFSTI: HC $1.00/MF $0.50 CSCL 11J

Research is reported using silicone SE-555 (white) to establish a method of sample preparation which will provide optimum vacuum-weight-loss values. Samples were used in the form of large pieces, as finely cut shreds, and as ground powders; exposure times were 24, 48, 72, and 96 hours. The effect of sample configuration on weight loss at 125° C and 10^{-6} torr is tabulated. Weight loss data for RTV silicone compounds at 125° C and 10^{-6} is also given in tabular form. C.T.C.

N66-10630*# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF SPECIFICATIONS FOR POLYMERIC MATERIALS Monthly Technical Progress Report No. 14, Jul. 10–Aug. 9, 1965
R. F. Muraca and J. S. Whittick 15 Aug. 1965 4 p Prepared for JPL
(Contracts NAS7-100; JPL-950745; SRI Proj. ASD-5046)
(NASA-CR-67754) CFSTI: HC $1.00/MF $0.50 CSCL 11J

A trial run of specification test procedures is described using a silicone elastomer (SE-555) in a standardized vacuum weight loss unit. Four weighed samples(±0.02 mgm) of the elastomer (about 1" × 2" × 1/16" each) were suspended in each of four sample chambers preheated to 125° C; evacuation was begun immediately. After 50 hours of exposure to the thermal-vacuum environment, one set of samples was removed and re-weighed; subsequently, the remaining sets were removed in order after 100, 200, and 300 hours. These samples were found to exhibit weight losses of 3.00%, 3.34%, 3.12%, and 3.85% for the respective exposure periods. C.T.C.

N66-10666*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERFORMANCE OF FIVE ABLATION MATERIALS AS COATING FOR STRUCTURES IN A REGION OF SEPARATED FLOW
Louis E. Clark and Allen G. Mc Lain Washington, NASA, Nov. 1965 32 p refs
(NASA-TN-D-3093) CFSTI: HC $2.00/MF $0.50 CSCL 11D

Material specimens of different thickness were tested on the cylindrical section of a rounded-ogive-cylinder model. The tests were conducted in the Langley 11-inch ceramic-heated tunnel at a heating rate, enthalpy, and free-stream Mach number typical of the values of these parameters encountered during a missile trajectory. Oil-flow and pressure tests showed that the boundary layer had separated from the cylindrical section of the model and that the entire specimen region was immersed in separated flow. In the separated-flow environment, a phenolic-cork composition was found to be superior to the other materials studied in limiting the substrate temperature rise. The phenolic-cork composition experienced considerably greater erosion than the phenolic-nylon, asbestos-phenolic, and subliming-salt compositions, which ranked second, third, and fourth, respectively, in limiting the substrate temperature rise; however, these materials developed either surface cracks or large fissures in the char layer. Preconditioning of the phenolic-cork, asbestos-phenolic, and epoxy-solid materials by heat cycling to 400° F (478° K) did not decrease their thermal performance. Author

N66-10712*# Emerson Electric Co., St. Louis, Mo. Electronics and Space Div.
PERFORMANCE EVALUATION OF "THERM-LAG" MATERIAL FOR ENTRY HEAT PROTECTION OF ADVANCED MANNED SPACECRAFT Material Development Report, 1 Oct. 1962–1 Apr. 1963
[1963] 205 p *Its* Rept.-1558
(Contract NAS9-877)
(NASA-CR-65166) CFSTI: HC $6.00/MF $1.25 CSCL 11A

The performance of Thermo-lag T-500 was evaluated for use as a heat protection material during manned spacecraft reentry. Presented are test data for solid-state thermal, mechanical, and environmental properties; and parameter evaluation data. All test data are presented in graphic or tabular form. R.N.A.

N66-10729# Lockheed-Georgia Co., Marietta. Nuclear Labs.
ELECTRICAL INSULATION MATERIALS, SNAP 8 RADIATION EFFECTS PROGRAM, VOLUME II Addendum
Jan. 1965 8 p Prepared for Aerojet Gen. Corp.
(ER-7591)

Additional test results on the statorette organic insulation system are reported. Insulation resistance measurements were made at ambient temperature and at periodic intervals as the temperature was increased to approximately 200° C, allowed to stabilize, and decreased to ambient. The irradiated statorette was dissected to observe the insulation around the inner conductors; the results are tabulated. Leak checking showed leakage around terminal connections in one group of statorettes, probably caused when the terminals were heated during connection to the oven lead wires for temperature cycling. Visual examination of another statorette group showed heavy powdering of the insulation around the inner conductors and throughout the winding, apparently due to poorly cured insulation.
M.G.J.

N66-10764# Naval Research Lab., Washington, D. C.
DIFFUSION RATES OF METHYL CHLOROFORM THROUGH SOME INSULATION MATERIALS
F. E. Saalfeld and M. V. Mc Dowell 28 Jul. 1965 12 p refs
(NRL-6302; AD-620113)

Diffusion rates of methyl chloroform through insulation and decorative materials cemented to aluminum surfaces with Bondmaster No. 596 neoprene contact adhesive have been studied; in addition, the permeability coefficients for ensolite and surface-covered corkboard to the above mentioned chlorinated hydrocarbon were measured. Rate-of-diffusion measurements indicate that methyl chloroform is trapped behind surface-covered corkboard for a longer time (>6 months) and emanates from the corkboard surface at a slower rate than for any other insulation material studied. One-inch Ensolite retains methyl chloroform longer than corkboard whose surface has not been covered or 1/2-in. Ensolite. Of the materials studied, the one with the greatest diffusion rate of methyl chloroform was uncovered corkboard. Methyl chloroform did not diffuse through the decorative laminate materials. On the basis of the data presented, a change of the corkboard cementing procedures in submarines has been recommended. Corkboard should be installed before being coated, and 1/2-in. Ensolite should replace the 1-in. material where possible.
Author (TAB)

N66-10780# Forest Products Lab., Madison, Wis.
EFFECT OF THERMAL CYCLING ON TENSILE AND COMPRESSIVE STRENGTH OF REINFORCED PLASTIC LAMINATES
Gordon H. Stevens Aug. 1965 9 p Issued in cooperation with MIL-HDBK-17 Working Group on Plastics for Flight Vehicles
(Contract AF 33(657)-63-358)
(FPL-37; AD-621576)

The paper presents the modulus of elasticity and strength values of four reinforced plastic laminates in tension and compression at room temperature and at 500F. Prior to evaluation at these temperatures, the test specimens were exposed to thermal-shock cycling. Three of the laminates evaluated in this study were reinforced with 181-A1100 glass fabric and represented three resin systems: a phenolic resin (CTL 37-9X), an epoxy resin (ERSB-0111), and a phenyl-silane (Narmco 534). The fourth was a phenolic-asbestos laminate made of R/M Pyrotex felt style 41-RPD. The effects of thermal chock cycling on properties vary with the type of resin and reinforcement. In general, thermal-shock cycling had less effect on modulus of elasticity than on strength. Properties at room temperature tended to decrease after exposure to cycling, while the properties of most laminates evaluated at 500F. were not seriously affected.
Author (TAB)

N66-10784# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD OF FASTENING RUBBER TO FABRIC
M. S. Dostyan and I. L. Shmurak 11 Jun. 1965 4 p Transl. into ENGLISH from Soviet Patent No. 159977 (Appl. No. 790458/23-4, 9 Aug. 1962) 1 p
(FTD-TT-65-192/1+4; AD-620124)

The object of the invention is a method of making rubber adhere to fabric. To improve the strength of the bond at the contact between rubber and rubber and rubber and fabric into the rubber mixture there is introduced 0.1 to 5 parts by weight of dichloride of tin.
Author (TAB)

N66-10837# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MODIFICATION OF THE PROPERTIES OF POLYPROPYLENE FIBERS
M. P. Zverev, R. A. Bychkov, T. F. Kostina, and V. S. Klimenkov 29 Jun. 1965 14 p refs Transl. into ENGLISH from Khim. Volokna (Leningrad), no. 3, 1964 p 15–19
(FTD-TT-65-261/1+2+4; AD-621057)

The study of the compatibility of the systems polypropylene–polystyrene showed that the positive values for the amount of contraction do not prove to be the criterion which determines the microcompatibility of crystalline polymers. There is brought out the proposition of the influence of the geometric dimensions of the macromolecules of the original polymers and what is connected with this the different dimensions of the secondary formations with the shifting of the polymers on the amount of contraction of the specific volumes is pointed out. The fibers obtained from a mixture of isotactic crystalline polypropylene and polystyrene have satisfactory physico-mechanical properties up to the content of not more than 12% by weight of the polystyrene in the polypropylene. The energy of the activation of the creep increases with the increase in the content of polystyrene in the polypropylene. This is brought about by steric obstacles created by the polystyrene, which make difficult the shifting of the structures of the polypropylene. Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N66-10262# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELEMENTS OF COMPUTER MATHEMATICS
S. B. Norkin, ed. 12 Aug. 1965 225 p refs Transl. into ENGLISH of "Elementy Ychislitel'noy Matematiki" Moscow, Gos. Izd. "Vysshaya Shkola", 1963 p 1–210
(FTD-MT-64-321; AD-620758)

Computation with approximate numbers of calculation of errors; Composition of tables of functions; Approximate solution of equations; Systems of linear equations; Interpolation polynomials; Approximate Calculation of integrals; Approximate integration of differential equations; Linear and parabolic approximation of functions by the method of least squares; and Practical harmonic analysis.
TAB

N66-10317*# Aeronautical Research Associates of Princeton, Inc., N. J.

COMMUNICATION PROBABILITIES FOR ORDERLY-SPACED SATELLITES

John C. Houbolt Washington, NASA, Nov. 1965 32 p refs
(Contract NAS1-4585)
(NASA-CR-327) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Probability equations for determining the percentage of time that communications are possible for various combinations of equal and random spacing of communications satellites are given. The equations are applied to selected communications links including Boston–London, and Los Angeles–Hawaii to bring out the effects of using equal spacing. Improvements are noted, but for randomly-spaced planes and equally spaced satellites per plane, the improvements are only small over the case of completely random distribution. Equally-spaced planes, and equal spacing of the satellites per plane, the most sophisticated ordering, gives the most improvement. L.S.

N66-10321*# National Aeronautics and Space Administration, Washington, D. C.

ON THE RESONANCE CONCEPT IN SYSTEMS OF LINEAR AND NONLINEAR ORDINARY DIFFERENTIAL EQUATIONS [UBER DEN RESONANZBEGRIFF BEI SYSTEMEN LINEARER UND NICHTLINEARER GEWOHNLICHER DIFFERENTIALGLEICHUNGEN]

Rahmi Ibrahim Ibrahim Abdel Karim (Ph.D. Thesis, Carolo-wilhelmina Polytech. Inst., Braunschweig, W. Ger.) Nov. 1965 173 p refs
(NASA-TT-F-300) CFSTI: HC $5.00/MF $1.00 CSCL 12A

Theorems on the resonance cases for linear and nonlinear ordinary differential equations of the first to the n^{th} order are derived and proved in detail, using an earlier report by the same author as partial basis. Minimal orders of magnitude of the solutions and their derivatives are given and methods for the formation of examples, with sample calculations in matrix notation, are described. Author

N66-10471# Oak Ridge National Lab., Tenn. Mathematics Div.

ON NONLINEAR MULTISTEP METHODS FOR ORDINARY INITIAL-VALUE PROBLEMS

William B. Gragg [1965] 7 p refs
(Contract W-7405-ENG-26)
(ORNL-P-1033; CONF-650207-1)

The operator

$$\alpha_k X_{n+k} + \ldots + \alpha_0 X_n - h[\beta_k X'_{n+k} + \beta X'_{n+s} + \beta_{k-1} X'_{n+k-1} + \ldots + \beta_0 X'_n] \sim c_{p+1}(s) X_n^{(p+1)},$$

a function of the real parameter s occurring in the theory of the numerical solution of initial-value problems by multistep methods, is considered. The errors of approximations to x_s and x'_s, for Hermite interpolation with equally spaced points, are found. Stability of the modified multistep operators with $\beta_k \neq 0$ and $\beta_k = 0$ is discussed, obtaining normalized families of operators of order $p = 2k + 1$ and $p = 2k$, respectively. Predictors are given for finding approximate values of x_{n+s}, x_{n+k}, in order to apply the general operator given above to the solution of the initial-value problems $x(a) = s$, $x' = f(t,x)$, $t \in I = [a,b]$. NSA

N66-10484 Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

SOLUTION OF VARIATIONAL PROBLEMS WITH BOUNDED CONTROL VARIABLES BY MEANS OF THE GENERALIZED NEWTON–RAPHSON METHOD

Paul Kenneth and Gerald E. Taylor Jul. 1965 33 p refs Presented at Symp. on Recent Advanc. in Optimization Tech., Carnegie Inst. of Tech., Pittsburgh, 21–23 Apr. 1965
(RM-289J)

The generalized Newton–Raphson method, an iterative procedure for solving nonlinear operator equations, has been extended in application to variational problems with bounded control variables. Two numerical examples are worked out in detail to demonstrate the practical aspects of the algorithm as well as its computational effectiveness. Author

N66-10495# European Space Vehicle Launcher Development Organization, Paris (France).

COORDINATES AND EQUATIONS IN THE DISCUSSION OF PROBLEMS OF ATTITUDE [COORDONNEES ET EQUATIONS DANS LA DISCUSSION DES PROBLEMES D'ATTITUDE]

E. Cambi Sep. 1965 16 p
(ELDO-TM-F-24) CFSTI: HC $1.00/MF $0.50

The choice of Euler's angles to represent notations, in discussions of some problems of three-dimensional geometry or mechanics, is not always the best. Very often, the employment of other parameters leads to more manageable equations. Therefore, the purpose of this note is to discuss the formal problems inherent in the utilization of parameters less customary than Euler's angles. Of particular interest are the four "parameters of Rodrigues" and direction cosines. Transl. by D.T.

N66-10520# Florida Univ., Gainesville. Dept. of Industrial Engineering.

AN ALGORITHM FOR GROUPING OBJECTS INTO MAXIMALLY HOMOGENEOUS GROUPS Technical Paper No. 327

Mario Padron Aug. 1965 40 p *Its* Eng. Progress at the Univ. of Fla., V. 19, No. 8

A procedure was developed which has the characteristics of always converging to the solution, never considering the same possibility twice, and naving the next step in the search completely determined after the previous one was considered. A method was constructed with the capability of locating the maximally homogeneous allocation in fewer trials than the number which would be required by the trivial method of constructing all allocations. An example was worked in which 26% of the total number of possible allocations were evaluated before reaching the solution. A second algorithm was constructed in the process of solving this allocation problem. The method starts from a given allocation and moves into another allocation by changing the location of exactly one object, and this is accomplished only if the second allocation yields a smaller value of the objective function. R.W.H.

N66-10571# David Taylor Model Basin, Washington, D. C.

OPTIMUM SUPER/HYPERSONIC LEADING-EDGE PROFILES

Roger J. Furey Jul. 1965 33 p refs
(DTMB-2035; DTMB-AERO-1091; AD-471674)

A system of differential equations governing the heating rate and pressure drag of a leading edge operating in hypersonic flow is developed. The resulting system constitutes a Mayer Problem in the Calculus of Variations. Difficulties encountered in solving this system of equations analytically led to the use of a numerical application of the Maximum Principles. The result is a series of two-dimensional and axisymmetric leading edges having either minimum heat input, minimum drag or the optimum leading edge considering both standpoints—drag and heat input. Author (TAB)

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N66-10615*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
[A STATISTICAL FORMULATION OF THE ESTIMATION AND THE COMBINED IDENTIFICATION AND CONTROL PROBLEMS. WORST CASE INITIAL CONDITION] Fifth Quarterly Report
R. Sridhar Apr. 1965 52 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950670)
(NASA-CR-67812) CFSTI: HC $3.00/MF $0.50 CSCL 12A

A literature survey was conducted and the results outlined for estimation problems involving continuous nonlinear dynamical systems and combined identification and control problems involving continuous dynamical systems with disturbances. The results are critically reviewed and an alternate statistical formulation is suggested for both problems. In addition, the worst case initial condition problem is considered for a class of dynamical systems which may be described by a set of first order differential equations. R.N.A.

N66-10626*# Drexel Inst. of Tech., Philadelphia, Pa. Mathematics Dept.
METHODS FOR SYSTEMATIC GENERATION OF LIAPUNOV FUNCTIONS (PART ONE)
R. L. Drake [1965] 380 p refs
(Contract NAS8-11196)
(NASA-CR-67863) CFSTI: HC $7.00/MF $2.00 CSCL 12A

A review is presented of Liapunov's stability theory as applied to the stability analysis of nonlinear control systems. Some definitions and basic theorems are given, and equations describing the control system are included. The problem of Lur'e is treated, as well as more recent results obtained by Lefshetz. Modifications of the restrictions on the admissable nonlinear characteristics are presented, and more useful results are obtained. The problem of Aizerman is considered, and includes a treatment of the general second order case due to Krasovskii. An example demonstrates the verification of Aizerman's conjecture for a particular third order control system. Two theorems of Popov are examined along with a discussion of the Liapunov function of Popov. A Kalman theorem is given relating the Popov criterion with criterion obtained using the Liapunov theory with a Popov type Liapunov function. A compendium of examples is included illustrating applications of the theory to particular problems. C.T.C.

N66-10627*# Drexel Inst. of Tech., Philadelphia, Pa. Mathematics Dept.
METHODS FOR SYSTEMATIC GENERATION OF LIAPUNOV FUNCTIONS, PART 2
R. L. Drake [1965] 321 p refs
(Contract NAS8-11196)
(NASA-CR-67864) CFSTI: HC $7.00/MF $1.75 CSCL 12A

This report summarizes much of the work that has done in the field of stability theory with regards to the generation of Liapunov functions. The emphasis of the report has been to survey and discuss the work of American engineers and mathematicians in this area. But since most of the work was motivated by Russian mathematicians and engineers, this report also includes a sizable discussion of the Russian contributions. Reference is also made to the contributions due to mathematicians in England, Japan and Italy. Under separate cover, the writers of this report submit a sizable list of references in the stability field and a summary of the theorems and definitions which are important in the analysis of stability problems. Author

N66-10653*# Stanford Univ., Calif. Dept. of Statistics.
R CHART CONTROL LIMITS BASED ON A SMALL NUMBER OF SUBGROUPS Technical Report No. 83
Frederick S. Hillier 4 Oct. 1965 20 p refs
(Contract Nonr-225(53))
(NASA-CR-67827) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Conventional control limits for the R chart provide an unreliable basis for indicating when the process has gone out of statistical control unless these limits are based on a fairly large number of subgroups. By using the method proposed, statistically sound control limits are obtained regardless of how few subgroups have been inspected. Thus, it is feasible to being applying the R chart reliably much sooner than was possible before. The method is simple and the interpretation of results is the same as with conventional control limits. An analogous method for setting X chart control limits based on a small number of subgroups was previously proposed. Since the R chart usually is used in conjunction with an X chart, it is possible to set statistically sound control limits for both charts as soon as desired. R.N.A.

N66-10692# Joint Publications Research Service, Washington, D. C.
CYBERNETICS, NO. 3, 1965
3 Nov. 1965 203 p refs Transl. into ENGLISH from Kibernetika (Kiev), no. 3, May–Jun. 1965 p 1–104
(JPRS-32714; TT-65-33193) CFSTI: $6.00

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10. AN ALGORITHM FOR THE SOLUTION OF THE PROBLEM OF OPTIMAL CUTTING OF A MATERIAL USING CIRCULAR PATTERNS AND HAVING LIMITATIONS ON THE DISTANCE BETWEEN THE PAIRS OF PATTERNS V. L. Rvachev and Yu. G. Stoyan p 140–152 refs

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N66-10755*# RAND Corp., Santa Monica, Calif.
OPTIMAL PROCEDURES FOR STOCHASTICALLY FAILING EQUIPMENT

Jon Folkman and Sidney Port Oct. 1965 30 p ref
(Contract NASr-21(11))
(NASA-CR-67689; RM-4598-NASA) CFSTI: HC $2.00/MF $0.50 CSCL 12A

A system is investigated which may be classified into one of three possible states: 0, 1, or 2. The 0 is a failed state, 1 is a turned off state, and 2 is a working state. If the system is in state 2 it can be turned off or let run. With the first decision the system goes instantaneously to state 1, while with the second the system remains in state 2 with probability beta, or goes into state 0 with the probability 1—beta. If the system is in state 1, nothing can be done which will leave the system in state 1 at the next time period, or the decision can be made to turn on. With this latter decision, at the next time period the system will be in state 2 with probability alpha, or in state 0 with probability 1—alpha. If the system is in state 0, nothing can be done which leaves the system in state 0, or the decision can be made to repair which will put the system into state 1 after m units of time. The problem is to determine the policy which maximizes the probability of having the system in state 2 at time n or n + k when at time 0 there are r spare parts for repairs, and determine what are these probabilities. R.N.A.

N66-10756*# Space Technology Labs., Inc., Redondo Beach, Calif.
MISSILE DYNAMICS FOR STABILITY ANALYSIS. VOLUME I: DERIVATION OF EQUATIONS
J. L. Palmer 9 Jul. 1963 103 p refs
(Contract NAS3-3231)
(NASA-CR-67681; STL-8414-6046-TU-000) CFSTI: HC $4.00/MF $0.75 CSCL 16D

This document covers the derivation of a set of linearized dynamic equations for use in missile stability analyses. The equations are presented in matrix form and represent the transfer function from engine command signal to gyro output signals. The derivation includes the effects of propellant sloshing, elastic deformation of the vehicle structure, and the dynamics of gimballed engines. The effects of fixed thrusting engines and the effects of inertia corrections to the bending data have also been considered. The vehicle structure is taken as a multi-branched beam under the influence of bending deflections, shear deflections, rotary inertia, and axial accelerations. The results are presented in terms of a set of generalized coordinates representing rigid body motion, bending deflections, engine deflections, and slosh mass deflections. The equations are transformed into normal coordinates and the results are also presented in terms of set of orthogonal combined modes. Author

N66-10761# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF CERTAIN FUNDAMENTAL TYPES OF COMPLEX EQUILIBRIUM STATES IN A THREE DIMENSIONAL SPACE
R. M. Mints 10 Jun. 1965 68 p refs Transl. into ENGLISH from Mat. Sb. (Moscow), v. 63, no. 2, 1964 p 169–214
(FTD-TT-65-352/1+2; AD-621058)

Certain fundamental types of complex equilibrium states are investigated for a system of three autonomous differential equations with analytic right sides or with right sides having a certain finite number of partial derivatives. The equilibrium state in which the real parts of all roots of the characteristic equation are nonzero is said to be simple; if this is not the case, the equilibrium state is said to be complex. All possible topological structures of complex equilibrium states of the type considered for the general case are established. A necessary and sufficient condition for coarseness of an equilibrium state in a three-dimensional space is determined and a criterion is given by which it is possible to distinguish between the resulting types of complex equilibrium states in terms of number and types of coarse equilibrium states for nearby systems. TAB

N66-10810# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
FUNCTIONS OF MARKOV PROCESSES
Murray Rosenblatt [1965] 19 p refs Sponsored in part by ONR
(AD-620684)

Conditions are discussed under which the first order transition probabilities of the derived process satisfy the Chapman-Kolmogorov equation, and under which the derived process is Markovian itself. TAB

N66-10812# RAND Corp., Santa Monica, Calif.
THE ENERGY MECHANICS OF SEMISTATIC SPACE-TIMES
Dominic G. B. Edelen Sep. 1965 36 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4484-PR; AD-620458)

A unique characterization of 4-dimensional, hyperbolic normal metric, or semistatic spaces, E, is given in terms of the admissible forms of the metric tensor. If the Einstein field equations are assumed to hold in E, the most general form of the momentum-energy tensor that supports a semistatic energy mechanics is obtained. It is shown that all cosmological line elements previously considered are conformally equivalent to a semistatic space in which the metric tensor on the hypersurfaces orthogonal to a time-oriented normal congruence in E, K, is Euclidean. All physical quantities can be determined in terms of the metric and curvature of the hypersurfaces orthogonal to K and one additional function of all four coordinates. These determinations are exhibited and provide a means whereby the hypersurface geometry is uniquely determinable in terms of the projection of the momentum-energy tensor onto the hypersurface. The treatment concludes with the study of a semistatic perfect fluid. Author (TAB)

N66-10816# RAND Corp., Santa Monica, Calif.
A COSMOLOGICAL KINEMATICS WITH PECULIAR MOTIONS
Dominic G. B. Edelen Aug. 1965 42 p refs
(P-3185; AD-620665)

The purpose of the discussion is to derive a line element without the assumptions of uniform mass density and the absence of peculiar motions, and then to derive the kinematical consequences of such a line element when the peculiar motions are included from the start. The results obtained in this manner, although similar in structure to those obtained from use of the Weil postulates, contain certain fundamental departures from previous thinking, and cast a certain amount of doubt on the velocityred-shift relations as currently interpreted. TAB

N66-10817# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
PERTURBATION THEORY OF THE SELF-CONSISTENT FIELD
A. K. Rajagopal 26 May 1965 22 p refs
(Contract ARPA SD-88)
(ARPA-15; AD-620056)

A perturbation theory of the self-consistent field is developed using a Green's function method after the manner of Peng. It is shown that a self-consistent perturbation theory yields the same answers as the conventional random phase approximation. The equivalence of the perturbation approach

to spin waves in metals developed by Herring and the random phase approximation for the same problem is seen to be an example of this. The effect of the weak periodic field on a Hartree-Fock electron system is here explicitly done both by the perturbation approach and the random phase approximation with the Green's function approach. The Green's function approach is finally generalized so as to include, in principle, correlations beyond the Hartree-Fock. Author (TAB)

N66-10852# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE THEORY OF DIFFRACTION BY A REFLECTING GRID
L. N. Deryugin 3 Aug. 1965 12 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 93, no. 6, 1953 p 1003–1006
(FTD-TT-65-567/1+2+4; AD-619430)

Analytical formulas are presented which give the distribution of the electromagnetic fields in the opening of the grooves and the coefficients of the reflection for the case where the width of the groover is small compared with the wavelength. TAB

N66-10853# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALGORITHMIC UNSOLVABILITY OF THE PROBLEM OF RECOGNIZING COMPLETENESS FOR A FINITE AUTOMATA
M. I. Kratko 5 Aug. 1965 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 1, 1964 p 35–37
(FTD-TT-65-586/1+4; AD-619432) CFSTI: HC $1.00/MF $0.50

The problem of recognizing completeness for a finite automata is considered with emphasis placed upon finding an algorithm which allows it to be shown whether any given base is complete or not. For the general case it is proven that the problem of recognizing completeness is algorithmically insoluble. In connection with this, there is established an algorithmic insolubility of certain other problems connected with the structural synthesis of automats and the problem of completeness. G.A.L.

N66-10860# Innsbruck Univ. (Austria). Inst. of Theoretical Physics.
A NEW METHOD TO SOLVE DIFFERENTIAL EQUATIONS: LIE SERIES AND THEIR APPLICATIONS IN PHYSICS AND ENGINEERING Final Report, 1 May, 1961–31 Aug. 1962
W. Gröbner and F. Cap [1962] 197 p refs
(Contract N62558-2992)
(AD-619491)

Contents: Theory of lie series Initial-value problems Boundary-value problems Optimum control systems. TAB

N66-10902# European Atomic Energy Community, Brussels (Belgium).
SUBJECTIVISTIC INTERPRETATION OF CONFIDENCE REGIONS [SUBJEKTIVISTISCHE INTERPRETATION DES KONFIDENZSCHLUSSE]
P. Ihm Jun. 1965 8 p Presented at the Kolloquium der Deutschen Reg. der Biometric Soc., Hannover, 25 Jan. 1964
(EUR-1623.d) CFSTI: HC $1.00/MF $0.50

In 1928 Jerzy Neyman defined the confidence intervals on the basis of an objectivistic probability theory in order to be independent of the subjectivistic components in Bayes' theorem. Practical experience and theoretical knowledge have led to the realization that the probability of error concept, on which confidence inference is based, is inadequate for the formation of judgements in scientific research. If, however, confidence intervals are interpreted as quantiles of standardized likelihood functions, which is possible with a certain family of distributions, they can then be explained in terms of a subjectivistic theory. Author

N66-10906# Northrop Corp., Newbury Park, Calif. Ventura Div.
APPLICATION OF INTEGRAL REPRESENTATIONS OF DISPLACEMENT POTENTIALS IN ELASTO-DYNAMICS
Robert P. Banaugh 20 Feb. 1964 29 p refs
(Rept.-2953; AD-601027)

With the aid of a gauge condition analogous to the coulomb gauge of electromagnetic theory, the integral form of the solutions of the three fundamental boundary value problems of elastodynamics are obtained. These solutions are given in terms of surface distributions of the displacement potentials and their derivatives together with volume distributions of the body forces, and surface distributions of the applied stresses and/or prescribed displacements. This paper considers problems involving more than one media, and also the corresponding two-dimensional problems. TAB

N66-10948# California Univ., Los Angeles. Dept. of Engineering.
OPTIMAL CONTROL THEORY APPLIED TO SYSTEMS DESCRIBED BY PARTIAL DIFFERENTIAL EQUATIONS
William Lloyd Brogan Jul. 1965 240 p refs
(Grant AF-AFOSR-699-65)
(Rept.-65-29; AD-619868)

The optimal control of dynamical processes which can be described by partial differential equation is considered. Linear partial differential equations are discussed in a general way. The question of state-controllability of distributed parameter systems is considered. Several methods are discussed for analyzing the optimal control problem for distributed parameter systems. Two of these techniques are a dynamic programming technique and a variational technique Using the dynamic programming method, the optimal control problems are reduced to the solution of a pair of two-point boundary value partial differential equations. A geometrical interpretation of the optimization problems and some algorithms for their numerical solution are given. TAB

N66-10949# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE CONVERGENCE OF FOURIER SERIES OF PRACTICALLY PERIODIC FUNCTIONS
Ye. A. Bredkhina 11 Aug. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 160, no. 2, 1965 p 259–262
(FTD-TT-65-584/1+4; AD-619485)

In this report a method is described, offering a series of new indications of uniform and absolute convergence of Fourier series of almost periodic (p.p) functions. It is based on the idea of the given function in the form of a sum of a finite number, or calculated number of p.p functions with limited spectra and is applicable preferably to class Q of uniform p.p functions, the Fourier indices of which have a finite number of specific points on each section of the real axis. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N66-10200# Battelle Memorial Inst., Columbus, Ohio. Remote Area Conflict Information Center.
THE STRUCTURE OF THE ATMOSPHERE IN AND ABOVE TROPCIAL FORESTS
R. C. Behn and R. A. Duffee 1 Aug. 1965 67 p refs
(Contract ARPA SD-171; Proj. Agile)
(BAT-171-8; AD-620799)

The report discusses the structure of the atmosphere and the microclimatology in and above tropical forests. The temperature, temperature inversions, wind, wind speed, humidity, evaporation rates, illumination, and the effects of seasons, day, and night on the temperature and humidity in tropical forests and above the canopy are reported. The effect of vegetation on the transmission of solar radiation into the forest, and the radiometeorological characteristics of the atmosphere above the canopy are also mentioned. Author

N66-10205 St. Louis Univ., Mo.
DESIGN, CALIBRATION, AND APPLICATION TECHNIQUES FOR A MICROBAROVARIOGRAPH
John Bicknell Godwin, Jr. (Ph.D. Thesis) 1965 133 p refs
(AD-466066)

This study deals with the measurement of small pressure variations with periods of oscillation of 0.5 to ten seconds, and the uses of such measurement. The pressure transducer selected is the electromagnetic microbarovariometer, first designed and used by Macelwane in 1938. It consists of a coil affixed to the center of a rubber diaphragm which is stretched over a brass cylinder. Pressure variations cause the diaphragm to move the coil relative to a fixed bar magnet, thus producing a current. Two of these units have been disassembled, modified, and reassembled to produce a single transducer. The coils have been rewound to the same specificiations, and the units are mounted face-to-face, using a single magnet between the two diaphragms. The leads of the coils are connected so that seismic interferences cause cancellation of current and atmospheric pressure variations give an additive current. A jacket of plexiglass seals the central chamber between the two diaphragms. A single inlet nozzle serves to input either atmospheric pressure or the signal from a pneumatic signal generator as desired. A technique for computing the relative energy and power involved in the pressure variations is developed and applied to the data for the trial period. Curves are plotted for both relative energy and relative power for the two and one-half day interval, and several distinct characteristics are noted. Prior to the passage of the cold front, relative energy and relative power dropped to a minimum level with the concentrations located in the longer-period oscillations. Author (TAB)

N66-10346# Navy Underwater Sound Lab., New London, Conn.
WIND-SPEED AND WIND-DIRECTION DISTRIBUTIONS AT ARGUS ISLAND OFF BERMUDA
Anthony J. Perrone, John M. Gorman, and Francis G. Weigle 24 Aug. 1965 26 p refs
(USL-683; AD-620221)

Argus Island wind information was systematically recorded and processed over a three-year period. The recording, processing, and analysis procedures used are described. Monthly mean wind speeds with standard deviations are compared with monthly median wind speeds and quartiles. Monthly distributions of wind speed are given, as well as yearly distributions. Cumulative distribution plots compare wind-speed occurrences over the three-year period. A time plot of daily mean and maximum wind speeds is given, and diurnal variations are discussed. The distributions of wind direction for each month are also shown. Author (TAB)

N66-10376# New York Univ., N. Y. Geophysical Sciences Lab.
WAVE SPECTRA ESTIMATED FROM WAVE RECORDS OBTAINED BY OWS WEATHER EXPLORER AND THE OWS WEATHER REPORTER (III)
L. Moskowitz, W. J. Pierson, Jr., and E. Mehr Jun. 1965 37 p refs *Its* Rept. 65-4
(Contract Nonr-285(57))
(AD-619523)

As a part of the problem of developing numerical wave forecasting procedures for the North Atlantic Ocean, selected sequences of the weather maps for the North Atlantic for which wave data were known to be available were studied in detail for the five year period beginning in April 1955 and ending in March 1960. Data from a hurricane in September 1961 have also been analyzed. Certain dates and times of observations were selected for a variety of reasons for study. For these dates and times, the National Institute of Oceanography provided copies of the wave records that were obtained by the OWS Weather Explorer and by the OWS Weather Reporter. In total, about 800 wave records were provided, and a complete spectral analysis has been made for 390 of these records. This report presents in tabular and graphical form the results of these analyses. TAB

N66-10475# Travelers Research Center, Inc., Hartford, Conn.
RADAR FORECASTING OF VISIBILITY RESTRICTIONS IN SNOW Interim Report
James W. Wilson Sep. 1965 30 p refs *Its* Rept.-7468-172
(Contract FA-65-WA-1192)
(SRDS-RD-65-74)

Quantitative echo-intensity data from two snowstorms, collected with the WSR-57 at Washington, D. C., are compared with visual-range data from 7 transmissometers located within 45 miles of the radar. In general, a high correlation exists between average radar received power and runway visual range; the coefficient of correlation exceeds 0.82 for stations within 35 miles of the radar during periods of significant changes in visual range. The relationship between visual range (V) and average radar-received power ($\overline{P}_r$) is of the form $\log V = A\overline{P}_r - B$, where A and B are constants. Ten- to 70-minute forecasts of visual range are obtained by extrapolating the radar echo pattern and converting the resulting echo intensities, by the above relationship, to visual range. Comparison of radar and persistence forecasts of visual range indicates that the radar forecasts are generally superior. Although further tests are required before weather radar can be recommended for operational use in visual-range forecasting, the possibilities look promising. Author

N66-10554# Joint Publications Research Service, Washington, D. C.
ATTENUATION OF VISIBLE AND INFRARED RADIATION BY ARTIFICIAL WATER FOGS
V. Ye. Zuyev, B. P. Koshelev, S. D. Tvorogov, and S. S. Khmelevtsov 22 Oct. 1965 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Fiz. Atm. i Okeana (Moscow), V. I, no. 5, May 1965 p 509–516
(JPRS-32511; TT-65-32990) CFSTI: $1.00

The results of a theoretical and experimental investigation of the optical and microphysical properties of artificial fogs are discussed. The derived quantitative data on the attenuation of infrared radiation in a fog, with polydispersivity and absorption in droplets taken into account, are compared with the results of an experimental determination of the spectral transparency of fogs. Author

N66-10577# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
METEOROLOGICAL DATA REPORT, AEROBEE AE 3.519 (AF 125-3) (12 AUGUST 1965)
Marjorie Mc Lardie Hoidale Sep. 1965 34 p
(ERDA-341; AD-470231)

Meteorological data gathered for the launching of Aerobee AE 3.519 (AF 125-3) are presented for the Air Force Cambridge Research Center and for ballistic studies. The data appear, along with calculated ballistic data, in tabular form. Author (TAB)

N66-10578# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
METEOROLOGICAL DATA REPORT, AEROBEE AF 3.375 (21 JULY 1965)
Marjorie Mc Lardie Hoidale Sep. 1965 57 p
(ERDA-334; AD-470229)

Meteorological data gathered for the launching of Aerobee AF 3.375 are presented for the Air Force Cambridge Research Center and for ballistic studies. The data appear, along with calculated ballistic data, in tabular form. Author (TAB)

N66-10821# Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography.
AN ATTEMPT TO DEVELOP A CLIMATOLOGY OF ICE ACCRETION Final Report, Nov. 1, 1962–Jul. 31, 1964
E. S. Epstein Aug. 1965 21 p
(Contract AF 19(628)-1693)
(AFCRL-65-584; AD-620919)

An attempt is made to develop a method for producing a climatology of ice accretion. It is found that the available data are not sufficient to produce such a climatology. A method is presented by which a climatology of occurrences of freezing precipitation could be derived, principally from standard radiosonde information. The principal statistical tool employed is multiple discriminant analysis. Were adequate quantitative data on ice accretion to become available at even limited number of locations the method could be extended to provide the desired climatology. Author (TAB)

N66-10836# McGill Univ., Montreal (Quebec). Arctic Meteorology Research Group.
THE BEHAVIOUR OF PLANETARY WAVES IN AN ATMOSPHERIC MODEL BASED ON SPHERICAL HARMONICS Scientific Report No. 1
André Robert Jun. 1965 93 p refs *Its* Publ. in Meteorol. No. 77
(Contract AF 19(628)-4955)
(AFCRL-65-488; AD-621073)

The grid point method commonly used in numerical calculations presents serious problems in experiments that require a global coverage of the meteorological variables. The shape of the earth and the form taken by the meteorological equations in a system where longitude and latitude are the basic coordinates, suggest the use of spherical harmonics for the horizontal specification of the variables. This method eliminates grid points and all the truncation errors due to the finite difference approximations. It also permits the retention of all the terms in the meteorological equations including those that would normally exhibit an anomalous behaviour near the poles. A model based on five levels and 15 coefficients was integrated for 200 days starting from an atmosphere at rest. The integration was then continued for another 20 days with 45 coefficients. Cross-sections show a jet stream in each hemisphere and low level easterlies along the equatorial belt. The amplitudes, the phase speeds and the structure of the planetary waves in the model compare favourably with their atmospheric equivalents. The results of this integration indicate that spherical harmonics could be used profitably in general circulation models and for the preparation of extended range forecasts. Author (TAB)

N66-10840# National Engineering Science Co., Houston, Tex.
THE EFFECTS OF INTERNAL WAVES IN THE EASTERLIES ON MESOSCALE WEATHER DEVELOPMENTS Final Report
Joseph L. Goldman and John C. Freeman, Jr. Jul. 1965 92 p refs
(Contract DA-28-043-AMC-00173(E))
(SN-192-2; AD-621256)

A model based on the general theory of internal waves presented in the Interim Report, and on the analyzed data from the western tropical Pacific is presented. The physical description of parameters results from the analysis of three cases of internal waves propagating along the inversion through the Hardtack network. A test of the theory for a simple case shows general agreement with existing data in development and propagation. The final numerical development of the theory appended in the report is general and can be used to test a large number of cases simultaneously. Also appended is a climatological study of rainfall over water in the tropics. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N66-10325*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APPLICATION OF AN ITERATIVE GUIDANCE MODE TO A LUNAR LANDING
Helmut J. Horn Washington, NASA, Nov. 1965 22 p refs (NASA-TN-D-2967) CFSTI: HC $1.00/MF $0.50 CSCL 17G

Several guidance modes for directing space vehicles are compared, and the iterative guidance mode in particular was used for a specific application, a lunar landing. Application of this mode to the problem confirms the expectation that for highly simplified problems, closed form solutions are available, can be used as steering equations, and are feasible for on-board computation. The mode handles disturbances beyond those expected in a real flight with a minimum of measurements. Payload loss is negligible, the landing accuracy does not deteriorate, and control requirements, especailly thrust control, are acceptable. The computation effort itself is modest. L.S.

N66-10540# Royal Aircraft Establishment, Farnborough (England).

SEPARATION STANDARDS IN THE NORTH ATLANTIC REGION, 1965–71, IN THE LIGHT OF RECENT MEASUREMENTS OF FLYING ERRORS

P. G. Reich Nov. 1964 37 p refs

(RAE-TR-64043) CFSTI: HC $2.00/MF $0.50

Interpretations are proposed for the sets of measurements which have been made of track-keeping and height-keeping errors. From these measurements, estimates are made of the elementary probabilities and frequencies which make up the expressions for collision risk derived in earlier papers of this series. Assessments are then made of the levels of safety implied in various lateral and vertical separation standards, which might be considered for the North Atlantic region, for the forecast traffic in the period 1965–71. There is also a brief discussion of longitudidal separation, for which there is not yet sufficient data to allow useful estimates of collision risk.

Author

N66-10690*# Philco Corp., Palo Alto, Calif.

THE SCHEDULE OF MEASUREMENTS FOR ANALYSIS OF AN ONBOARD NAVIGATION SYSTEM

Paul J. Rohde Huntsville, Ala., NASA. Marshall Space Flight Center, 15 Oct. 1965 49 p

(Contract NAS8-11198)

(NASA-CR-61107) CFSTI: HC $2.00/MF $0.50 CSCL 17G

This document is concerned with the selection of a measurement schedule for an onboard navigation system. The instrument which is considered to be of interest is the sextant or theodolite. Three sets of auxiliary schedule data are presented to act as engineering guides in the selection of stars and planetary bodies along the trajectory of interest. The use of this auxiliary data is demonstrated along a round trip Mars trajectory and a lunar trajectory. The value of using the auxiliary data as a guide is verified by obtaining tracking schedule evaluation data from a digital computer simulation of an onboard tracking system.

Author

N66-10793# Federal Aviation Agency, Washington, D. C. Traffic and Economic Analysis Branch.

AN ANALYSIS OF ITINERANT AIR TRAFFIC, JACKSONVILLE ARTCC, 1970 AND 1975 Interim Report

Donald L. Dunlap Jul. 1965 59 p refs

(RD-65-89; AD-620019)

This report contains forecasts of the 1970 and 1975 itinerant air traffic within the Jacksonville ARTCC control area. The forecasts describe annual, peak day, peak hour of peak day, IFR and VFR traffic. Two possible control area configurations are described. One is the present Jacksonville ARTCC control area; the other is the combined Jacksonville–Miami ARTCC control areas. A plausable configuration of the peak hour traffic is described in terms of abbreviated flight plans which indicate type of aircraft, true air speed, origin, time of entrance into the control area, destination, and route of flight.

TAB

N66-10855# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF SELF-CONTAINED NAVIGATION DURING FLIGHTS IN ORBITS NEAR PLANETS

I. K. Bazhinov 1 Jun. 1965 16 p Transl. into ENGLISH from Russian

(FTD-MT-65-148; AD-619479)

A simple method is presented of self-contained solution by cosmonauts of navigational problems during flight in orbits near planets by means of carrying out of astronavigational observations and measurements of altitude of flight. Thus, astronauts have to conduct simple calculations with the use of special navigational tables. The presence on board of any kind of computers is not obligatory.

TAB

N66-10864# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN INVESTIGATION OF NOISE AND BIAS EFFECTS ON DOPPLER-INERTIAL NAVIGATION SYSTEM ACCURACY

Jack Carson Snead (M.S. Thesis) Jun. 1965 135 p refs

(GGC/EE/65-13; AD-619972)

An analytical investigation is performed to determine and compare the performances of four second-order and third-order Doppler-inertial navigation system configurations when subjected to sensor errors. This is done by determining the steady-state rms velocity output error due to noise and bias inputs for the gyro and Doppler radar and by determining the characteristics of the transient error in velocity due to step inputs of accelerometer, gyro, and Doppler bias. Simulation of the system error models in block diagram form is accomplished by Midas programming of a digital computer. The noise analysis simulation is based on the assumption that the random process is ergodic and representable by an exponential autocorrelation function. The results indicate that system performance is highly dependent upon the manner of utilizing the mixed Doppler-inertial velocity information in feedback loops and upon the dynamic response characteristics required of the system. Midas digital simulation was found to be a useful analytical tool for studies of this nature.

Author (TAB)

N66-10884*# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.

INFLUENCE OF ATMOSPHERIC TURBULENCE ON AZIMUTH LAYING TECHNIQUES Final Technical Summary Report

M. Leen et al 15 Jun. 1965 173 p refs *Its* Eng. Rept. 7994

(Contract NAS8-11142)

(NASA-CR-67769) CFSTI: HC $5.00/MF $1.00 CSCL 17G

The purpose of this study is to find methods of predicting the size of errors caused by atmospheric turbulence, and to compare such predictions with actual measurements made on a typical alignment theodolite. Another purpose is to investigate the possibility of modifying the design or use of such theodolites to reduce the errors. Current theory of light transmission through a turbulent atmosphere predicts that the rms deviation of a collimated beam depends on the temperature gradient. Measurements were made to verify this dependence and determine the extent to which actual factors of proportionality can be predicted. The random nature of the turbulence has been investigated and the theoretical form of the autocorrelation function and the power density spectrum determined. These functions have also been calculated from experimental data and comparison verifies the theoretical model. Theoretical and experimental comparison of the action of a roof prism and a trihedral lead to the conclusion that there is no correlation between the noise from these two types of return optics. A discussion and bibliography on the subject of atmospheric attenuation in the visible and near infrared portion of the spectrum is included.

Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N66-10100# Atomics International, Canoga Park, Calif.
MAGNETIC MOMENTS AND VEHICLE TORQUES IN THE SNAP 10A
T. J. Boyle and R. M. Galantine 1 Oct. 1965 43 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11207) CFSTI: $2.00

Small magnetic dipole moments arise in the SNAP 10A nuclear electric power system due principally to the permanent magnet in the electromagnetic pump and current flowing in the thermoelectric converter. The dipole moments interact with the earth's magnetic field to produce torques on the orbiting vehicle. This report describes the nature of these torques, discusses the procedures which have been used to evaluate them, and discusses methods for reducing them. Author

N66-10191# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
IRRADIATED FUEL ELEMENT GAMMA SCANNING RIG: OPERATION AND INSTRUMENTATION
C. E. Bridges and J. A. Mounsey London, HMSO, 24 Jun. 1965 43 p refs
(TRG-1005(W)) HMSO: 6s

The gamma scanning rig is used to measure the long- and short-term burn-up and power production over the length of fuel elements primarily irradiated in the WAGR. This information is derived from the measurement of the total gamma activities of all fission products together with the measurement of the activities of specific fission products using gamma spectrometry techniques. The gamma activity may be presented as an analogue display on a recorder with the element continuously scanned, and also in digital form on a strip printer and tape puncher with the element stationary at preselected points of the scan. The methods adopted to control the scanning operations, and the instrumentation used to obtain the measurements are described. The elements are described in sufficient detail for use by maintenance personnel. Author

N66-10195# Commissariat a l'Energie Atomique, Saclay (France).
STUDY OF URANIUM–PLUTONIUM LATTICES IN VARIOUS MODERATORS [ETUDE DES RESEAUX URANIUM–PLUTONIUM DANS DIFFERENTS MODERATEURS]
1965 139 p refs In FRENCH
(Contract EURATOM-037-60-12 RDF)
(EURAEC-1201; EURAEC-1202; EURAEC 1203; EURAEC 1204; EUR-2070.f) CFSTI: HC $4.00/MF $1.00

Research in uranium–plutonium lattices in various moderators was conducted, with primary emphasis placed upon thermalization experiments. Methods for the effective calculation of energy transfer moments in thermalization, and the application of these methods to several representative moderators are presented. Several simple models for usual thermalization media are described, and theoretical methods for the study of neutron thermalization in an absorbing, infinitely homogeneous medium are discussed. Critical experiments with fuels slightly enriched in uranium 235 and plutonium are also reviewed.
Transl. by G.A.L.

N66-10274# Los Alamos Scientific Lab., N. Mex.
MEASUREMENT OF THE POWER-TO-CORE TEMPERATURE TRANSFER FUNCTION OF KIWI-B-4E
J. Douglas Balcomb [1964] 10 p refs
(Contract W-7405-ENG-36)
(LA-DC-6845; CONF-650610-19)

During the full power hold of the restart of the Kiwi-B-4E reactor, a noise signal was fed into the temperature control system in order to cause reactor power perturbations. The purpose was to obtain a measurement of the dynamic response of core temperature to changes in power over a range of frequencies. The resulting power perturbations were 67 MW peak-to-peak and 10.6 MW rms and the observed temperature perturbations were 2.9° R to 5.7° R rms depending on the sensor location. The results have been analyzed utilizing the cross-correlation method and have produced excellent results which agree fairly well with the mathematical models which have been used for stability analysis and controller design. The range of frequencies covered in the experiment is from 0.025 to 0.7 cps. The experiment has shown that good quality data can be obtained from one or more minutes of steady-state reactor operation without interference to the control system, the operators, or the reactor performance. Author

N66-10334*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
CRITICAL MASS STUDIES WITH NASA ZERO POWER REACTOR II. I: CLEAN HOMOGENEOUS CONFIGURATIONS
Thomas A. Fox, Robert A. Mueller, C. Hubbard Ford, and Donald L. Alger Washington, NASA, Nov. 1965 21 p refs
(NASA-TN-D-3097) CFSTI: HC $1.00/MF $0.50 CSCL 18I

The NASA Zero Power Reactor II (ZPR-II) has been used to determine experimentally the critical masses for more than a tenfold range of highly enriched (93.2 percent U^{235}) aqueous uranyl fluoride fuel concentrations in clean cylindrical geometries. The ZPR-II reactor tank permits the assembly of cylindrical cores 76.2 centimeters (30 in.) in diameter and with lengths (heights) up to 90 centimeters either bare or radially reflected by about 15 centimeters (6 in.) of water. The specific range of fuel concentrations was from hydrogen to uranium^{235} atom ratios of about 150 (167 g U^{235}/liter of fuel solution) to 1650 (15 g U^{235}/liter). In addition to the critical masses, data are presented on the temperature coefficient of reactivity and the incremental reactivity worth at criticality for a similar range of concentrations. Some of the physical properties for the fuel concentrations are presented, based on measurements made at the Lewis Research Center. A brief description of the ZPR-II and the experimental procedures used are also included.
Author

N66-10350# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Monthly Progress Report, Sep. 1965
Albert V. Crewe and Stephen Lawroski 20 Oct. 1965 92 p refs
(Contract W-31-109-ENG-38)
(ANL-7105) CFSTI: $3.00

Technical progress is reported in the areas of liquid metal cooled reactors, general reactor technology, advanced systems research and development, and nuclear safety. The coring of the Gravel Gertie structure was completed. Preliminary results show that there was uranium present during the test and that there is a uranium gradient in the gravel. No uranium above background levels can be detected in the top 5 feet of gravel. A prototype aluminum core support grid was machined from 6-inch thick plate, and is being set up for an experimental stress study. Materials compatibility tests are being conducted on samples of beryllium, aluminum, and stainless steel in various ratios of exposed surface area. Initial tests with beryllium indicate somewhat lower corrosion rates as the exposed surface area is increased. R.R.D.

N66-10445# Argonne National Lab., Ill.
FARET CORE I FUEL IRRADIATION PROGRAM AND REFERENCE DESIGN

P. J. Persiani, T. R. Bump, and W. J. Kann Oct. 1965 27 p refs
(Contract W-31-109-ENG-38)
(ANL-7106) CFSTI: $2.00

Specifications are outlined for the reference design of the Fast Reactor Test Facility (FARET) Core I. Discussions are included on the basic core plan, thermal considerations, instrumented fuel subassemblies and fuel element design, core composition and configuration, considerations in planning the experimental program, FARET critical experiments which include control rod experimental results and establishing the concept of mixed core systems, and the experimental program.
R.N.A.

N66-10464# Atomics International, Canoga Park, Calif.
SNAP 10A EXPANSION COMPENSATOR
S. Sudar, ed. 1 Oct. 1965 68 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-9778) CFSTI: $3.00

The SNAP 10A Nuclear Power Unit (NPU) utilizes two expansion compensator units (ECU) as follows: (1) to absorb the volumetric increase of NaK due to thermal expansion, (2) to provide a void-free NaK system, and (3) to regulate the NaK system pressure. In order to fulfill these system operation requirements, an ECU has been developed which utilizes a welded bellows fabricated from AM-350 (SCT-850) precipitation hardening steel foil. For increased reliability, the ECU has a secondary NaK containment housing which permits continued system operation at design power in the event of a bellows failure. An extensive development test program was conducted on separate bellows capsules and ECU's to evaluate fatigue life, pressure capability, and endurance performance in a high temperature-liquid metal (NaK-78) environment. The parameters affecting welded bellows quality—the material cleaning, welding and heat treating—have been thoroughly investigated. Extensive statistical regression and correlation studies have been performed to establish a suitable weld bead width versus penetration ratio and the size control limits of the bellows welding process. The secondary containment ECU design is presently in the 90-day endurance phase of the Qualification Test Program. Expansion compensators have been installed in all SNAP 10A Ground Test and Flight Systems and the performances of all units to date have been satisfactory.
Author

N66-10474# Atomics International, Canoga Park, Calif.
PREDICTED NUCLEAR CHARACTERISTICS OF THE HNPF FIRST CORE
M. P. Aronchick 1 Aug. 1965 52 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7913) CFSTI: $1.25

The predicted nuclear characteristics of the HNPF first core, fueled with 140 elements composed of a U–10 wt % Mo alloy enriched to 3.6 wt % U^{235}, are presented. The initial k_{eff} is predicted as 1.088, the control rod worth as 14.6% Δk, and the sodium worth as 4.8% Δk. The methods used to obtain these results are described and compared with experimental results from the HNPF Exponential Experiment. One- and two-dimensional power profiles are presented and discussed, and an overall power peak-to-average ratio of 2.78 is predicted. First-core burnup estimates and kinetics parameters are also presented.
Author

N66-10512# Martin Co., Baltimore, Md. Nuclear Div.
STRONTIUM 90-FUELED THERMOELECTRIC GENERATOR POWER SOURCE FOR FIVE-WATT U. S. COAST GUARD LIGHT BUOY Addendum I
W. Kenneth Nichols, Jr. and William A. Mc Donald Apr. 1964
22 p refs
(Contract AT(30-1)-3043)
(MND-3043-1)

A brief survey is given of the history of the development of radioisotope, reactor, and solar-cell space power supplies. Power supplies using heat directly—the ROVER rocket propulsion reactor, the PLUTO nuclear ramjet, and the POODLE rocket thruster using ^{210}Po—are described. The power systems using heat to generate electricity are discussed. Development of the reactors SNAP-2, SNAP-8, SNAP-10A, and SNAP-50 is surveyed. Requirements of isotope generators and the characteristics of ^{238}Pu, ^{90}Sr, ^{137}Cs, ^{244}Cm, and ^{210}Po for SNAP applications are discussed. The isotope generators SNAP-3, SNAP-9A, SNAP-11, SNAP-17, AND SNAP-19 are described.
(NSA)

N66-10541# Atomic Energy of Canada, Chalk River (Ontario).
THE EFFECT OF NEUTRON IRRADIATION AND HYDROGEN CONCENTRATION ON TENSILE PROPERTIES OF THE CANDU COOLANT TUBE SPACER ALLOY
C. E. Ells and A. Sawatzky Jun. 1965 31 p refs
(AECL-2272) CFSTI: HC $2.00/MF $0.50

The effect of neutron irradiation on tensile properties of the Zr-2.5 wt% Nb–0.5 wt% Cu alloy was evaluated for neutron fluxes up to 3×10^{20} n/cm^2 (E > 1.0 MeV). Quenching of the alloy from the ($\alpha + \beta$)-phase and subsequent over aging resulted in a stable condition at 300° C. The material was not severely embrittled by the fast neutron flux; even specimens prehydrided to 250 ppm retained 45% reduction in area at 300° C after 0.9×10^{20} n/cm^2 irradiation exposure. The alloy became markedly susceptible to severe embrittlement if it was taken into the β-phase immediately prior to the final metallurgical operation. Increased hydrogen concentrations had very little effect on the tensile properties in the unirradiated condition of the alloy, but tended to lower the reduction in area of specimens irradiated to $\approx 10^{20}$ n/cm^2.
G.G.

N66-10557# United Kingdom Atomic Energy Authority, Warrington (England). Reactor Group.
BRITISH NUCLEAR POWER DEVELOPMENT WITH GAS-COOLED REACTORS
R. V. Moore 1965 10 p
(TRG-1047(R)) CFSTI: HC $1.00/MF $0.50

The development of nuclear power production from gas cooled reactors in Britain is surveyed, from the beginning in 1945 with the setting-up of the Atomic Energy Research Establishment at Harwell, followed by an engineering organization at Risley to control production of fissile materials. Air cooled reactors were operating at Windscale in 1950, and in 1956 the first carbon dioxide cooled reactor at Calder Hall produced electricity. The operation of the U.K.A.E.A's eight uranium metal fueled reactors is reviewed, and details are given of progress with the first commercial nuclear power program which will provde 5000 MW(e) by 1970. The prototype uranium dioxide fueled advanced gas cooled reactor began to operate at Windscale in 1963, and its successful record is summarized. The second nuclear power program embraces further stations, of at least 5000 MW(e), to be commissioned by 1975. The first will be the 1200 MW(e) AGR station at Dungeness, which is expected to produce electricity more cheaply than any other type of power station. The potential for developing the AGR and reducing costs from the system is surveyed; AGR's are considered to be competitive in cost in many countries other than Britain.
Author

N66-10588# European Atomic Energy Community, Brussels (Belgium).
TESI: AN ADVANCED POWER EXCURSION REACTOR FOR RESEARCH IN REACTOR SAFETY, PRELIMINARY STUDIES
C. Rinaldini, V. Coen, C. Foggi, S. Galli de Paratesi, F. Lanza et al Jun. 1965 191 p refs
(EUR-2433.e) CFSTI: HC $5.00/MF $1.25

The main features of the power excursion reactor for safety tests (TESI) are described. An account is given of the work performed on this subject and the lines along which the studies have been developed are sketched out. TESI is a Treat type reactor, the performance of which is improved by increasing the maximum final operating temperature; and by reducing by a factor two the fissile concentration in the reactor core. Both these provisions lead to a higher final integrated neutron flux which is available to perform various tests, up to complete destruction, on a wide range of fuel elements and other reactor components. Two versions of TESI have been studied: the mean temperature version, in which a zirconium alloy fuel element cladding ensures fission product retention; and the high temperature version in which no metallic canning is present, so that full advantage is taken of the graphite properties at high temperature. The following table shows the characteristics of TREAT and of the two versions of TESI. Author

N66-10600# Metallgesellschaft, A. G., Frankfurt am Main Germany).
THE INFLUENCE OF NEUTRON IRRADIATION ON THE PROPERTIES OF Zr3Nb1Sn [UNTERSUCHUNG DES EINFLUSSES DER NEUTRONENBESTRAHLUNG AUF DIE EIGENSCHAFTEN DER LEGIERUNG Zr3Nb1Sn]
W. Jung-Konig, H. Richter, W. Spalthoff, and E. Starke (Inst. für Reaktorphysik der GKSS) Brussels, EURATOM, Jun. 1965 53 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-092-62-7 RDD)
(EUR-2071.d) CFSTI: HC $3.00/MF $0.50

Zr3Nb1Sn samples and Zircaloy-2 reference samples were subjected to neutron bombardment at various doses in the FRG-1 swimming-pool reactor at about 45° C. At test temperatures of 20 and 300° C, irradiation gave rise in the case of both alloys to a roughly equal percentage of increase in yield strength and reduction of elongation. The extent of the changes in the mechanical properties is in direct ratio to the integrated fast neutron flux dose. With increasing integrated neutron flux, however, the mechanical properties tend towards limit values. At a test temperature of 450° C no irradiation effect is observed. Irradiation has no effect on the rupture necking. The notch impact strength of Zr3Nb1Sn is enhanced by irradiation. Annealing treatments at 300–360° C, after irradiation, lower the notch impact strength by bringing about hardening processes. Corrosion tests carried out under irradiation in steam at 400° C in autoclaves showed that the corrosion attack in Zr3Nb1Sn, measured by means of weight increase, had doubled. In the case of Zircaloy-2 a still higher corrosion increase was found.
Author

N66-10656# Atomics International, Canoga Park, Calif.
AEC UNCLASSIFIED PROGRAMS Annual Technical Progress Report, Fiscal Year 1964
31 Aug. 1964 420 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9999) CFSTI: $5.00

Annual technical progress is presented on advanced sodium cooled reactors, Hallum nuclear power facility research and development, advanced organic moderated reactors, reactor safety, separations chemistry, and advanced reactor development.
R.N.A.

N66-10665# Los Alamos Scientific Lab., N. Mex.
PLUTONIUM REACTOR FUEL DEVELOPMENT Quarterly Status Report, Period Ending Aug. 20, 1964
25 Sep. 1964 15 p
(Contract W-7405-ENG-36)
(LA-3163-MS) CFSTI: $0.50

Activities are discussed on LAMPRE Core II postmortem, the containment of Pu–Fe and Pu–Co–CE fuels, joining developments, and fuel container mass transport studies. Developments are reported on the fast reactor core test facility nondestructive testing and construction progress. Also presented are developments in liquid metals technology, molten salt blanket systems, and neutronics.
R.N.A.

N66-10675*# Atomics International, Canoga Park, Calif.
TUNGSTEN RESONANCE INTEGRALS AND DOPPLER COEFFICIENTS First Quarterly Progress Report, Jul.–Sep. 1965
S. G. Carpenter, J. M. Otter, R. K. Paschall, and H. N. Royden 29 Oct. 1965 22 p refs
(Contract NAS3-7982)
(NASA-CR-54769; AI-65-225) CFSTI: HC $1.00/MF $0.50 CSCL 18J

Nuclear data required for calculations of resonance integrals, Doppler coefficients, and sample reactivities were compiled and evaluated. Effective resonance integrals were calculated for two sample sizes with varying isotopic compositions. Real and adjoint fluxes for the SGR-CA lattice being used were calculated. Reactivity worths were calculated for an axial void and for samples of tungsten, U^{238}, and carbon. Axial and source traverses were made in the central void in the SGR-CA, the expected cosine shapes being obtained. Reactivity measurements under cadmium were made on natural tungsten, gold, lead, depleted uranium, aluminum, stainless steel, and lavite. Results indicate that a sensitivity of more than 0.01 is obtained for single reactivity measurement taking 100 sec. They also indicate that reactivity effects associated with scattering and structural materials are negligible. Measurements with and without cadmium end caps demonstrated that end effects are quite small. All measurements and calculations indicate that the method proposed for measuring resonance integrals and Doppler coefficients of tungsten samples is capable of getting good results.
R.N.A.

N66-10680# Argonne National Lab., Ill.
DESIGN AND PERFORMANCE CHARACTERISTICS OF EBR-II CONTROL ROD DRIVE MECHANISMS
E. Hutter and G. Giorgis Aug. 1964 35 p
(Contract W-31-109-ENG-38)
(ANL-6921) CFSTI: $1.00

Presented is a description of the mechanical design of the control rod drives installed in the Experimental Breeder Reactor-II (EBR-II) primary tank. The major features and operating characteristics of the control rod drive design and improvements made up to and including wet criticality experiments, are summarized. Each control mechanism is an electrically driven device which moves a control rod 14-in. in a vertical direction at a normal rate of 4.76 in./min. Each drive features a pneumatic piston coupled with a hydraulic shock absorber which effect acceleration and deceleration of the fast, downward scram stroke. Included are data on the primary tank and the reactor vessel assembly. Data from full-stroke cycling, scramming, and gripper operations tests, and latch release measurements; which were made in air and sodium environments, are reported. As a result of these tests and consequent minor design improvements, the EBR-II control drive rod mechanisms have accumulated more than two years of operation without any malfunction in reactor control.
S.C.W.

N66-10707# Argonne National Lab., Ill.
ADDENDUM TO HAZARD SUMMARY REPORT, EXPERIMENTAL BREEDER REACTOR-II (ERB-II)
L. J. Koch, W. B. Loewenstein, and H. O. Monson 7 Jan. 1964 327 p refs
(Contract W-31-109-ENG-38)
(ANL-5719, Addend.)

The various changes which have developed during the construction of the Experimental Breeder Reactor-II are described. Other changes, evaluations, and test results relevant to reactor and plant safety are treated in the appendices. A summary is also presented of the various hazards considerations. R.N.A.

N66-10708# Atomics International, Canoga Park, Calif.
POST-IRRADIATION EXAMINATION OF SURFACE FILM FORMATION ON OMRE DRIVER ELEMENT NO. 219
R. J. Sullivan, R. B. Cassidy, H. Mandel, and R. T. Keen 1 Aug. 1964 39 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9637) CFSTI: $1.00

Methods of hot cell examination of the fuel plates of an OMRE stainless-steel clad fuel element after 282 Mwd irradiation to determine the extent and composition of surface film deposits are described and discussed in this report. The fuel plates, examined after removal following the Core II irradiation cycle, showed thin film deposits which followed the burnup profile on the fuel plate. Measurements showed that the film increased from ~0.2 μ at the inlet end of the fuel plates to a maximum of 3.5 to 3.6 μ at the high flux area of the plates and diminished to ~0.9 μ at the outlet end. The average fouling rate was observed to be 0.007 μ/Mwd and 0.036 μ/operating day. Examination indicated that the film deposits consisted of particles ~1 μ in diameter containing an inorganic center composed primarily of magnetite surrounded by an organic matrix. Author

N66-10737# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
MEASUREMENTS OF BUCKLINGS AND VOID EFFECTS IN D_2O-MODERATED, ORGANIC- OR H_2O-COOLED LATTICES OF UO_2 ROD CLUSTERS
Frederick D. Benton Jun. 1964 24 p refs
(Contract AT(07-2)-1)
(DP-873) CFSTI: $0.50

Material bucklings for a variety of UO_2 rod clusters on a triangular 9.33-inch lattice pitch in D_2O were determined by substitution experiments in the process development pile. Measurements were made with clusters of 19, 31, and 37 half-inch UO_2 rods in which the coolant media were varied to include D_2O, H_2O, organics, or air. The bucklings, which were determined both by a one-group perturbation method and by a two-group flux matching method, ranged from 0.80 to 5.60 m^{-2}. Author

N66-10738# Los Alamos Scientific Lab., N. Mex.
MULTIREGION THERMAL ANALYSIS OF TUBE BUNDLES WITH MOLTEN REACTOR FUEL IN FREE CONVECTION
Roy A. Axford (Northwestern Univ.) 9 Mar. 1965 79 p refs
(Contract W-7405-ENG-36)
(LA-3168) CFSTI: $3.00

The two-dimensional, fully developed temperature and velocity fields occurring in molten reactor fuel tubes in triangular tube bundles are analyzed on a coupled, multiregion basis. The three regions are the molten reactor fuel region, the tube wall region, and the coolant region. The molten reactor fuel is assumed to be in laminar flow, while the coolant is either slug flow or laminar flow. Analytical and numerical results for the temperature and velocity fields of the three regions and the circumferential variations in the inside and outside tube wall surface temperatures, the tube wall temperature drop, and the inside and outside tube wall heat fluxes are presented. It is found that the inside tube wall surface temperature variation is less for a molten reactor fuel than for a solid fuel region. It is also found that in the limit of a vanishing Rayleigh number the temperature fields in a triangular tube bundle with a molten reactor fuel approach those found in tube bundles with a solid fuel region. Author

N66-10747*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WHEEL-FLOW GASEOUS-CORE REACTOR CONCEPT
John C. Evvard Washington, NASA, Nov. 1965 13 p refs
(NASA-TN-D-2951) CFSTI: HC $1.00/MF $0.50 CSCL 18I

The wheel-flow gaseous-core reactor concept suggested in this report employs a cylindrical or toroidal core of hot fissioning uranium or plutonium fuel. This core is surrounded by a rotating annular region of propellant that enters and leaves the reactor tangentially. If the two flows rotate together as a wheel, no shear will occur at the interface between the propellant and the fuel. Hence, the fuel loss due to the mixing processes associated with shear would be minimized. Several reactor geometries employing or modifying the wheel-flow concept are suggested. These range from the basic cylindrical shape to toroidal geometries employing rotation about the jet axis to establish a radially outward centrifugal force. The stability problems in the flows and the possible use of magnetic fields and electric currents for damping of instabilities are briefly discussed. Author

N66-10967# Argonne National Lab., Ill.
SAFETY ANALYSIS REPORT FOR THE ARGONNE ADVANCED RESEARCH REACTOR CRITICAL EXPERIMENT
C. N. Kelber, E. F. Groh, and K. E. Plumlee Jun. 1965 54 p refs
(Contract W-31-109-ENG-38)
(ANL-6929) CFSTI: $3.00

The hazards of zero-power critical experimentation utilizing a core of the proposed design of the Argonne Advanced Research Reactor (AARR) are reported. The design includes a centeral, hexagonal water-filled flux trap (each side 6 cm long) inside a modified fuel annulus containing 13.5 to 70.3 kg of highly enriched uranium, plus water moderator and stainless steel. A beryllium radial reflector is included. No unsafe condition or undue hazard is associated with this facility. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N66-10041 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF SIMILITUDE IN PULSE MULTITURN COILS
A. G. Limar' and Yu. A. Litvinenko *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 477–483 refs (See N66-10001 01-25)

The problem of obtaining strong magnetic fields in coils cooled to cryogenic temperatures is discussed and the application of the methods of similitude theory to this problem is described. It is shown that for complete description of the system it is sufficient to conduct experiments on one coil in the necessary interval of variation. E.E.B.

N66-10101# Joint Publications Research Service, Washington, D. C.
MINISTRY OF HIGHER AND SECONDARY NEWS OF HIGHER EDUCATIONAL INSTITUTIONS, SPECIALIZED EDUCATION, USSR. RADIOPHYSICS SERIES, VOLUME VI, NO. 4, 1963
28 Feb. 1964 418 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy MViSSO SSSR po Razdelu Radiofizika (Gorki), v. 6, no. 4, Jul.–Aug. 1963 p 655–871 fizika (Gorki), v. 6, no. 4, Jul.–Aug. 1963 p 655–871
(JPRS-23436; OTS-65-21677) CFSTI: $6.00

Journal articles on various aspects of radiophysics are presented. For individual titles see N66-10102–N66-10127.

N66-10116 Joint Publications Research Service, Washington, D. C.
SOME CASES OF THE DEPENDENCE OF PERIODIC MOTIONS OF A RELAY SYSTEM ON THE PARAMETERS
V. A. Brusin, Yu. I. Neymark, and M. I. Feygin *In its* News of Higher Educational Inst. 28 Feb. 1964 p 261–292 refs (See N66-10101 01-23) CFSTI: $6.00

Some cases of the dependence of periodic motions of a relay system on the parameters are investigated. The results obtained are illustrated using as an example the forced oscillations of an oscillator with dry friction and bifurcations of the simplest symmetrical periodic motion. Author

N66-10117 Joint Publications Research Service, Washington, D. C.
STABILITY OF ONE NONLINEAR DYNAMIC SYSTEM
G. V. Aronovich *In its* News of Higher Educational Inst. 28 Feb. 1964 p 293–309 refs (See N66-10101 01-23) CFSTI: $6.00

The stability is investigated for hydraulic processes in a pressure system of a hydroelectric station with equalizing reservoir of variable cross section, in the case when the equilibrium state of the system lies on the line of matching of the two nonlinear differential equations that describe the behavior of the system. The differential equations differ from each other on the two sides of the matching line, starting from the first-order terms. The results of simulating the process on a computer are presented. Author

N66-10154# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INSTRUMENTS AND EXPERIMENTAL TECHNIQUES Selected Articles
30 Jun. 1965 21 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 1, 1964 p 121–123, 183–186, 197–198
(FTD-TT-65-320/1+2+4; AD-617908)
CONTENTS:

1. SUPPRESSION OF NOISE WHEN OBSERVING A NUCLEAR MAGNETIC RESONANCE SIGNAL OF A MAGNETIC FIELD MEASURER G. S. Anufriev, O. F. Afonin, and B. A. Mamyrin p 1–5 refs (See N66-10155 01-09)

2. AUTOMATIC CALCULATION OF DISLOCATIONS A. L. Sobolev and Yu. V. Sokurenko p 6–13 refs (See N66-10156 01-26)

3. DETERMINING THE COMPOSITION OF FILLING A DIFFUSION CHAMBER IN ITS SENSITIVE LAYER L. V. Bakanov, A. P. Grayevskiy, V. D. Lebedev, and M. V. Stabnikov p 13a–16 refs (See N66-10157 01-06)

N66-10175 European Organization for Nuclear Research, Geneva (Switzerland).
A HIGH PRECISION AIR CORE MAGNET
E. Gygi and F. Schneider 4 Aug. 1965 18 p refs
(CERN-65-29)

The realization of an axial symmetric field is described. The air core coil with an over-all length of 50 cm and an inner diameter of 13 cm produces on the axis, over a length of 30 cm, a field which is constant to $\pm 4 \cdot 10^{-4}$. At a distance 4 cm from the axis, over the same length the precision is $\pm 9 \cdot 10^{-4}$. The method of calculation, the production of the oxidized aluminum bands from which the coil is wound, and the construction of the coil assembly are described. Author

N66-10392* National Bureau of Standards, Boulder, Colo.
EFFECTS OF LONG-TERM STABILITY ON THE DEFINITION AND MEASUREMENT OF SHORT-TERM STABILITY
J. A. Barnes and D. W. Allan *In* NASA. Goddard Space Flight Center Short-Term Freq. Stability 1965 5 p refs (See N66-10381 01-07) GPO: $1.75; CFSTI: MF $1.50

Several authors have reported the measurement of a "flicker noise" spectrum for the frequency fluctuations, below a few cycles per second, of good quartz crystal oscillators. Experimental work carried out at the National Bureau of Standards at Boulder is in good agreement with these results. The influence of this longer term type of noise turns out to be of considerable importance in the definition and measurement of shorter term noise, since averages of this short-term noise normally cover a total averaging time well into the flicker noise region. A mathematical formalism which satisfactorily avoids convergence difficulties has been developed around a set of physically meaningful quantities. Some theoretically reasonable definitions of short- and long-term stability are given.
Author

N66-10425*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROCEEDINGS OF THE MAGNETICS WORKSHOP Technical Memorandum, Mar. 30–Apr. 1, 1965
Joseph G. Bastow, comp. 15 Sep. 1965 412 p
(Contract NAS7-100)
(NASA-CR-67605; JPL-TM-33-216) CFSTI: HC $7.00/MF $2.00 CSCL 20H

Proceedings from magnetics workshop meetings which dealt with the measurement and reduction of spacecraft magnetic fields are reported. Among the topics discussed were: problems of magnetic contamination; the establishment of spacecraft magnetic criteria and design restraints; Mariner mars magnetic mapping tests; resonance technique for measurement of satellite magnetic dipole moment; the prolonged exposure of human subjects to magnetic fields; and the prediction and allocation of total spacecraft magnetic moment. G.A.L.

N66-10463# Los Alamos Scientific Lab., N. Mex.
THE COEXISTENCE CURVE OF He^3
Robert H. Sherman [1965] 7 p refs Submitted for Publication
(Contract W-7405-ENG-36)
(LA-DC-7086; Conf-650428-1)

Results are presented of some recent pressure-volume-temperature measurements on He^3 in the critical region. A significant departure was found in the shape of the coexistence curve from the behavior expected for classical systems such as Xe and CO_2. Values are tabulated for the densities of He^3 liquid and vapor along the coexistence curve from experiments and some of the properties of He^3 at the critical point are also given. R.N.A.

N66-10479# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SHIMMING AN IRON-CORE ELECTROMAGNET TO PRODUCE UNIFORM MAGNETIC FIELDS
Paul J. Calcanes and Albert L. Loeffler, Jr. Feb. 1965 30 p refs
(RM-266)

The method of increasing field homogeneity of iron-core electromagnets by shimming is discussed. It is demonstrated that shimming the pole faces can appreciably increase the uniformity of the field. This increase in uniformity is especially pronounced at high field strengths where the unshimmed field may have no uniformity whatsoever due to saturation effects. E.E.B.

N66-10500# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Physik Inst.
SOURCE THICKNESS EFFECT IN BETA-SPECTROSCOPY. [QUELLENDICKENEFFEKTE IN DER BETA-SPEKTROSKOPIE]
I. Hofmann and H. Baier 1964 8 p refs Presented at the Fall Meeting of the Austrian Physics Society, Graz, 1964 Submitted for Publication
(SGAE-PH-13/1964) CFSTI: HC $1.00/MF $0.50

The β spectrum of ^{24}Na was investigated on an intermediate image spectrometer using sources of various thicknesses. The shape-factor diagram obtained, normalized to the same activity, is given. A non-surface equal, thickness-dependent distortion of the permitted spectrum was obtained. The distortion signifies that sources of greater thickness emit more electrons on the inlet screen of the spectrometer than thin sources. A comparison was made between the measured and calculated spectra for 3 mg/cm^2 NaCl. NSA

N66-10580# Rohm and Haas Co., Huntsville, Ala. Redstone Arsenal Research Div.
A MICROWAVE TECHNIQUE FOR STUDYING DETONATION PHENOMENA
Edgar G. Johnson 13 Sep. 1965 26 p refs
(Contract DA-01-021-ORD-11-909(Z))
(S-87; AD-469632)

A microwave technique was developed for studying shock phenomena in condensed phases. The microwave energy reflected by the shock front was used to determine velocities of both reactive (detonation) and non-reactive shocks. This technique used standard microwave components and an expendable, dielectric rod waveguide as a transmission line to the sample under study. The oscillogram of the output of a crystal detector is a continuous displacement-time track of the shock front as it moves through the sample. The trace can be interpreted in terms of microwave interferometry, in that the detected signal goes through a maximum and a minimum for each displacement of the shock front by a half wavelength, or as the Doppler shift in frequency produced by the velocity of the approaching shock front. This technique has been applied to the problem of determining the growth to detonation near the 50% card gap value of 1-inch diameter charges of Composition C-4 explosive and of 2-inch diameter charges of NH_4ClO_4 confined in glass. Simultaneous microwave and streak-camera measurements of the detonation of 2-inch diameter charges of pentolite were made. Author (TAB)

N66-10587# Weapons Research Establishment (Australia). Dept. of Supply.
THE SUPPRESSION OF HARMONIC DISTORTION IN PHOTOGRAPHIC IMAGES
R. E. Little Aug. 1965 19 p refs
(ISD-62) CFSTI: HC $1.00/MF $0.50

Harmonic distortion in the photographic images of sinusoidal objects can be reduced to a negligible amount by the formation of positive images provided certain conditions of exposure and development are met. A modulation transfer function can be found for the linearized system, which is found to have significance in the formation of images of objects other than sine waves. Author

N66-10623# General Dynamics/Astronautics, San Diego, Calif. Engineering Dept.
ACOUSTIC BUFFETING OF A SIMPLY SUPPORTED PANEL
R. W. Schwarz 30 Dec. 1964 41 p refs
(GD/A-EER-AN-535)

A theoretical method is presented for the derivation of the exact frequency and response equations for a simply supported panel subject to a random acoustic load. The structure is assumed to act as a multiple degree of freedom system and the acoustic pressure wave is assumed to have a normal incidence. Author

N66-10651*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EXPERIMENTAL NOISE STUDIES OF INLET-GUIDE-VANE–ROTOR–STATOR INTERACTIONS FOR A SINGLE-STAGE AXIAL-FLOW COMPRESSOR
John L. Crigler and W. Latham Copeland [1965] 16 p refs Presented at the 70th Meeting of the Acoust. Soc. of Am., St. Louis, 3–6 Nov. 1965
(NASA-TM-X-56903) CFSTI: HC $1.00/MF $0.50 CSCL 20A

Experimental studies were conducted on rotor–stator interaction noise and inlet-guide-vane–rotor interaction noise for a single stage axial flow compressor. The apparatus and test procedure are described. The acoustic data are presented in the form of noise radiation patterns which show the sound pressure as a function of azimuth angle. These noise radiation patterns were obtained with a narrow band filter analyzer centered at the fundamental blade passage frequency. For the configurations studied the radiated noise levels due to the interactions of rotor and downstream stator vanes are appreciably less than those due to inlet guide vane and rotor interactions. It was possible to correlate variations in the noise levels with a knowledge of local flow conditions in the vicinity of the blades. R.N.A.

N66-10664# California Univ., La Jolla. Dept. of Physics.
MAGNETIC COORDINATES
Carl E. Mc Ilwain [1965] 30 p refs Presented at Advanced Study Inst. of IIT Res. Inst., Bergen, Norway, 16 Aug. 1965
(UCSD-SP-65-3)

The definitions and properties of the magnetic coordinates B, L, K, Φ_o, R, λ and Λ are reviewed. The roles these parameters play in the study of geomagnetically teapped particles are discussed in detail. The intrinsic accuracy of the magnetic shell parameter L is examined as are the accuracies which are desired, available, and possible. A plea is made for the adoption of standard methods of presenting results. Author

N66-10720# Los Alamos Scientific Lab., N. Mex.
ON ELECTRICAL CONDUCTIVITY IN DETONATION PRODUCTS
Bernard Hayes 1964 6 p refs
(Contract W-7405-ENG-36)
(LA-DC-6993)

The purpose of this paper is threefold: to discuss electronic techniques appropriate to high-resolution electrical conductivity measurements in the detonation products of condensed explosives; to present evidence to show that if the detonation products contain free carbon, that carbon is the main conductor of electricity; and to demonstrate the usefulness of the measurement technique to explore reaction-zone structure. Author

N66-10760# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
LOW TEMPERATURE CREEP DEFORMATION OF CRYSTALS PARTICULARLY PHENOMENA AT LIQUID HELIUM TEMPERATURES Final Report, 1 Mar. 1960–1 Mar. 1965
Anthony Arko and J. Weertman 1 Jun. 1965 13 p refs
(Contract AF 49(638)-1041)
(AFOSR-65-1484; AD-620337)

Creep behavior of cadmium and mercury were investigated in the liquid helium temperature range with emphasis on the possible mechanisms of creep. Creep was found to be temperature dependent at all temperatures of investigation down to 1.75 K, and impurities in the metals had no noticeable effects. Activation energies were determined in the range 1.75–30 K and activation volume measurements were carried out. Creep behavior in the liquid temperature range was found to differ little from the usual low temperature creep at higher temperatures. At liquid helium temperatures, however, creep did not follow low temperature theories, but correction could be made by Alefeld's new rate equation for processes at low temperatures. Quantum tunneling effects on creep were found to be unimportant at temperatures above 0.04 K.
Author (TAB)

N66-10772*# National Bureau of Standards, Boulder, Colo. Boulder Labs.
CRYOGENIC RESEARCH AND DEVELOPMENT Tenth Progress Report, Period Ending Jun. 30, 1963
30 Jun. 1963 37 p refs Prepared for NASA
(NASA-CR-67682; NBS-7921) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Progress is reported on cryogenic research and development on the physical properties of hydrogen, cryogenic instrumentation, thermophysical properties of cryogenic materials, and cooldown of cryogenic transfer lines. R.N.A.

N66-10823# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW METHOD OF IMAGE SCANNING
D. S. Lebedev and D. G. Lebedev 15 Jun. 1965 7 p Transl. into ENGLISH from Vestnik Akad. Nauk SSSR, no. 11, 1964 p 44–46
(FTD-TT-65-212/1+2+4; AD-620129)

The methods of scanning, using the characteristics of vision for describing the image with the minimum number of figures, are investigated for use in communication theory.
Author (TAB)

N66-10875# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SURFACE RESONANCE ON A REFLECTING GRID
L. N. Deryugin 3 Aug. 1965 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 94, no. 2, 1954 p 203–206
(FTD-TT-65-566/1+2+4; AD-619429)

The surface resonance in the diffraction of a flat wave impinging normally on a reflecting grid with narrow grooves is investigated. This resonance is compared to the diffraction at a distance from the resonance. TAB

N66-10942 Royal Greenwich Observatory, Herstmonceux (England).
TIME AND LATITUDE SERVICE APRIL–JUNE, 1964
R. v. d. R. Woolley London, HMSO, 1965 17 p *Its* Roy. Obs. Bul. No. 94 HMSO: 3s

Time and latitude observations made with a photographic zenith tube, radio time signals, and clock comparisons are tabulated. The Varian rubidium gas cell frequency standard was used to provide a link between the cesium standard and the clocks of the Royal Greenwich Observatory. E.E.B.

N66-10964# Stanford Univ., Calif. Stanford Linear Accelerator Center.
PROPERTIES OF SYMMETRIC QUADRUPOLE MAGNET TRIPLETS
K. L. Brown and A. C. Hindmarsh Aug. 1965 52 p ref
(Contract AT(04-3)-400)
(SLAC-47) CFSTI: $2.00

A study of the properties of symmetric quadrupole magnet triplets is given, and the results are presented in graphical form. Configurations are considered in which the middle magnet is either twice the length of the other two or of the same length. Properties are given for the point-to-point focus and the parallel-to-point focus. In the first case, a beam emerging from a point object is focused to a point image in the horizontal and vertical planes simultaneously. In the second case, an entering parallel beam is focused to a point image in both planes simultaneously. The tabulations are normalized for applicability to systems of any aperture or magnet length.
C.T.C.

N66-10975# Columbia Univ., New York. Lubrication Research Lab.
EXACT AND APPROXIMATE THEORY FOR LINEARLY-COMPLIANT LAYER WITH INFLEXIBLE ADHESIVE BACKING
Harold G. Elrod, Jr. 1 Jul. 1965 32 p
(Contract Nonr-4259(06))
(TR-2; AD-470721)

This report develops the normal surface traction, normal surface displacement relations for a compliant layer adhering securely to a firm, flat foundation. Exact displacement responses are obtained for the one-dimensional (line) normal stress kernel and for the one-dimensional stress patch or double step. A stable approximate differential equation is derived relating traction and displacement. This differential equation can be conveniently coupled with Reynolds equation to solve problems in compliant-surface lubrication. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N66-10070# European Atomic Energy Community, Brussels (Belgium).
PRECISE REDETERMINATION OF THE $P_K\omega_K$ VALUE AND THE FLUORESCENCE YIELD OF Cr
W. Bambynek, E. De Roost, A. Spernol, W. Van Der Eijk, and R. Vaninbroukx Sep. 1965 8 p refs
(EUR-2524.e)

The K-shell fluorescence yield of Cr has been remeasured to be $\omega_K = 0.277 \pm 1.5\%$ by determining the absolute KX-ray emission rates and the absolute disintegration rates of ^{54}Mn sources. The KX-ray emission rates have been measured using a large 4π pressure proportional counter and a medium geometry solid angle arrangement. The disintegration rates have been determined by means of a calibrated γ-spectrometer and the $4\pi(AX,\gamma)$-coincidence method. A detailed discussion of all corrections and errors is given.
Author

N66-10071# Nihon Univ., Tokyo (Japan). Dept. of Physics and Atomic Energy Research Inst.
POLE MODEL OF NON-LEPTONIC DECAY CONSISTENT WITH DECAY PARAMETERS AND SUM RULES
Shoichiro Kawasaki (Chiba Univ.), Mitsuo Imoto, and Shin-ya Furui (Ibaraki Univ.) [1965] 24 p refs
(NUP-65-11)

A model is proposed for hyperon decay which shows that $K_1^0 \rightarrow 2\pi$ is not forbidden but can occur. Previous models are discussed, the assumptions of the proposed model are given, and the interactions used in the model are defined. The allowed graphs and their matrix elements for each hyperon decay process are given. Further, the results show that hyperon decay $\Sigma \rightarrow n + \pi^+$ is uniquely determined to be pure P-wave process consistent with recent experiments. E.E.B.

N66-10075# Aarhus Univ. (Denmark). Inst. of Physics.
RANGE CONCEPTS AND HEAVY ION RANGES. NOTES ON ATOMIC COLLISIONS, II
J. Lindhard, M. Scharff, and H. E. Schiott Copenhagen, Kongelige Danske Videnskabernes Selskab, 1963 46 p refs *Its* Math.-Fys. Medd. Vol. 33, No. 14 CFSTI: HC $2.00/MF $0.50

A theoretical discussion is given of the range of heavy ions with moderate velocity. Use is made of a simple velocity proportional Thomas-Fermi type formula for electronic stopping, and a universal approximate differential cross section for scattering. Simplified models of nuclear scattering assuming power law scattering are also included. They turn out to be useful for exploratory computations of various range quantities. The straightforward theory of ranges is studied. Range curves are computed for any atomic numbers of particle Z_1, and substance Z_2. It is found that when nuclear stopping is dominating, a $\varrho - \epsilon$ plot gives a universal range energy description. Probability distribution in total range and various averages are studied in order to assess corrections to measurements when necessary. Similarly, corrections to measurements of projected ranges are obtained. The range correction due to nuclear stopping is obtained for ions of high initial energy. A survey is given of numerous recent measurements of range. They are found to be in fair accord with theoretical results, for energies between 100 MeV (fission fragments) and ~ 1 keV.
Author

N66-10115 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF SYNCHROTRON OSCILLATIONS OF ACCELERATED PARTICLES WITH ACCOUNT OF BEAM-POSITION FEEDBACK
V. A. Bertulis *In its* News of Higher Educational Inst. 28 Feb. 1964 p 238-260 refs (See N66-10101 01-23) CFSTI: $6.00

The differential equations of excited nonlinear synchrotron oscillations are considered. The choice of the parameters for the accelerator and for the elements of the positional-feedback system for the accelerated charged-particle beam is considered.
Author

N66-10146# Argonne National Lab., Ill.
A GENERAL THEORY OF FIRST-PASSAGE DISTRIBUTIONS IN TRANSPORT AND MULTIPLICATIVE PROCESSES
J. E. Moydal Jun. 1965 26 p refs
(Contract W-31-109-ENG-38)
(ANL-7061)

The Milne problem, expressed in probabilistic terms, is solved for general transport and multiplicative processes. A general solution is given in the form of a convergent series whose terms are obtained by iteration; this solution is unique if and only if the probability of an infinity of atomic events before a first passage (which is the limit of a certain nonincreasing sequence) is identically zero. The mathematical theory that leads to this solution is a generalization of the corresponding theory for time-dependent Markov processes in which the time variable is replaced by a set of surfaces ordered by inclusion of their "insides," and is valid for Euclidean space of any number of dimensions. Applying it to the four-dimensional space of special relativity with ordered sets of space-like surfaces, one obtains a Lorentz-invariant formulation of the theory of physical Markov processes. A few examples are given. Author

N66-10150# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING A CHARGED PARTICLE, INTERSECTING A METAL SCREEN
D. M. Sedrakyan 28 May 1965 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk. (Erevan, Armenia), v. 17, no. 1, 1964 p 113-121
(FTD-TT-65-117/1+2; AD-621054)

Consideration is given to radiation originating at the intersection between a charged particle and an ideal conductive semiplane at a given distance from the edge of the semiplane. Present is, on one hand, radiation of a charged particle intersecting a screen and connected with diffraction of its field by a metal screen, and on the other hand, corrections to transient radiation of the charged particle in the presence of screen edge.
TAB

N66-10187# Tokyo Univ. (Japan). Inst. for Nuclear Study.
ANALYSIS OF THE HIGH-ENERGY JETS. PART IV: FOUR-MOMENTUM TRANSFER AND TRANSVERSE MOMENTUM OF RECOIL NUCLEON
Nobuo Yajima (Nagoya Univ.) and Shunichi Hasegawa 21 Dec. 1964 14 p refs
(INSJ-84) CFSTI: HC $1.00/MF $0.50

A method of identifying the recoil proton among secondary thin tracks is presented, and formulas are given for obtaining the four momentum transfer and the transverse momentum of the recoil proton. A practical analysis of experimental data is included, and the transverse momentum is presented for 17 jets identified as the recoil proton. M.G.J.

N66-10188 European Organization for Nuclear Research, Geneva (Switzerland).
QUANTUM THEORY AND ELEMENTARY PARTICLES

Victor F. Weisskopf 2 Jul. 1965 24 p Presented at the meeting of the American Phys. Soc., Washington, D. C., 23 Apr. 1965
(CERN-65-26)

The theory of quantum mechanics is discussed in relation to Newton's statement recognizing the logical necessity of elementary particles in order to explain the existence of materials with well-defined properties. It is pointed out that the number of elementary particles has essentially been reduced to three—proton, neutron, electron; however, the existence of these particles still remains an assumption. Some examples of transition between nucleon states are given, and transitions from an excited state to a lower one are considered. The SU(3) symmetry group is described, and some conclusions are drawn from the existence of the SU(3) or SU(6) multiplets. M.G.J.

N66-10189# Brookhaven National Lab., Upton, N. Y. Chemistry Dept.
SOME ASPECTS OF ELECTRON EXCHANGE REACTIONS IN SOLUTION
Norman Sutin [1965] 9 p refs
(Contract AT(30-2)-GEN-16)
(BNL-9171; Conf-650520-2)

Studies of electron transfer reactions are reviewed, and equations for calculating the inner sphere and outer sphere reactions are presented. Since no bonds are made or broken during outer sphere electron transfer reactions, the calculation of their rates is less difficult, in principle, than the calculation of ordinary chemical reaction rates. Some observed and calculated rate constants for electron transfer reactions at 25° are tabulated, and comparison shows good agreement. Exceptions are the $Fe^{2+} - Co^{3+}$, $Fe(phen)_3^{2+} - Co^{3+}$ and $Ru(NH_3)_6^{2+} - Co(NH_3)_6^{3+}$ reactions, which involved the cobalt (II)–cobalt (III) couple. It may be that spin multiplicity restrictions or other electronic factors are responsible for the anomalous behavior of these systems. Comparison tables on observed and calculated rate constants for some hydrated electron reactions, and for some inner sphere reactions are also included. M.G.J.

N66-10194# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
APPLICATION OF THE ISOBARIC MODEL TO THE NUCLEON COMPTON EFFECT
Nghiem Xuan Hai Sep. 1965 17 p refs
(TH-110) CFSTI: HC $1.00/MF $0.50

In the development of an isobaric model to approximate the pion–nucleon resonances, standard definitions of kinematics and invariants are given; nonisobaric graphs are computed; and the use of the isobaric model for resonances is introduced. The differential cross section at 90°, and 130°, and the angular distribution for 245 MeV photons are reproduced. It was found that the two-pion contribution is very important for fitting the refined features of the cross section. The 400 to 600 MeV region was used to determine the value of the NN annihilation S-wave; and this value was compared to the overall strength given by a σ particle model. Fair agreement was obtained. M.G.J.

N66-10196 Little (Arthur D.), Inc., Cambridge, Mass.
ISOTOPES IN INDUSTRY. TRENDS IN THE INDUSTRIAL USE OF RADIOISOTOPES AND IONIZING RADIATION
Final Report
E. W. Stone, J. H. B. George, and H. P. Beutner 24 Sep. 1965 140 p refs
(Contract AT(30-1)-3337)
(NYO-3337-16) CFSTI: $1.50

Results of a survey on the industrial applications of radioisotopes and ionizing radiation indicate that the use of radioisotopes in research, in process control instrumentation, and in nondestructive testing is increasing. The industrial use of ionizing radiation for processing plastics, medical supplies, chemicals, and semiconductors is another major innovation. Factors which influence the growth of isotope applications are discussed, and it is pointed out that an important influence is the presence of an individual or group with training, experience, and enthusiasm to stimulate the use of isotope techniques in solving production problems. Gaging, radiography, tracer studies, and radiation processing are given as the most important uses, and segments comprising the radioisotope industry are listed. The experiences of such users as the metals, electrical, chemical process, and consumer products industries; and transportation equipment, crude petroleum and natural gas, utilities, and mining companies are summarized. M.G.J.

N66-10208# European Atomic Energy Community, Brussels (Belgium).
A NUMERICAL SOLUTION OF THE GAMMA TRANSPORT EQUATION APPLIED TO CONCRETE SLABS
H. Penkuhn 1965 19 p refs
(EUR-2488.e) CFSTI: HC $1.00/MF $0.50

The gamma transport equation is solved numerically in plane multislab geometry. A monoenergetic source is assumed on one surface, with isotropic or collimated angular distribution. After computing the unscattered flux, the fluxes at lower energies are calculated using those at higher energies without iteration. Integration of the differential fluxes gives the energy spectra and buildup factors. Source energies $\leq$ 10 MeV and thicknesses of some dozen mfp can be handled with the present program. As application, buildup factors for normal and heavy concretes are calculated and compared with those of Al, A, and Fe. The so-called Z_{eff} results for heavy concretes to be a function of the source energy. Author

N66-10264# Oak Ridge National Lab., Tenn. Neutron Physics Div.
A NEW METHOD FOR THE EVALUATION OF NEUTRON EMISSION, KERMA, KERMA EQUIVALENT, DOSE EQUIVALENT AND THE SPECTRUM BELOW 1 MeV (α, n) SOURCES, USING BONNER SPHERES
S. K. Mehta Jul. 1965 85 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1171)

Neutron emission (F), kerma (K), kerma equivalent (Keq), dose equivalent (DE), the ratios K/F, Keq/F, and an upper bound to the neutron spectrum below 1 MeV, have been obtained for Am-Be, Pu-Be, Po-Be, and Am-B neutron sources by using modified Bonner sphere neutron spectrometer. The spectrometer consisted of 0- to 12-in.-diam. Bonner spheres and 0- to 3-in.-diam. spheres modified by the addition of boron and cadmium covers. The results were computed by the OPTIMO linear programming code which synthesizes optimal combinations of the response of the various spheres. The known smoothness of the neutron spectra from the source is utilized, and an upper bound to the spectra above 5.5 MeV, is taken from other measurements, since the response of the Bonner spheres does not have enough variation above 5.5 MeV. The response of the modified spheres to monenergetic neutrons was calculated by assuming exponential absorption below 1 KeV, and by S_n transport calculations above 1 KeV. The values of DE/F in units of rems/neutron-cm.^{2} for the Am-Be, Pu-Be, Po-Be, and Am-B sources are $(3.79 \pm 0.23) \times 10^{-8}$, $(3.72 \pm 0.28) \times 10^{-6}$, $(3.84 \pm 0.19) \times 10^{-8}$, and $(3.75 \pm 0.21) \times 10^{-8}$, respectively. The errors given refer to the 68 percent confidence intervals and include all known sources of error. Author

N66-10268# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research and Dept. of Physics.
THE RANDOM PHASE APPROXIMATION IN THE MANY BOSON PROBLEM
R. D. Etters [1965] 11 p refs Presented at Am. Phys. Soc. 1965 Ann. Meeting, New York, 27–30 Jan. 1965
(Contract AT(11-1)-72)
(IS-1111; Conf-758-26)

The equation of motion method is used to determine the excitation spectrum of a many-boson system. It is found that the equation of motion for the operator

$$\mu_k^+ = \Sigma_p \alpha(p,k) A_{p+k}^+ A_p$$

when linearized by the RPA, yields an approximate excitation spectrum of the same form as found by Bogoliubov. $\alpha(p,k)$ is a c-number coefficient. However, the result requires no a-priori assumption concerning the population of a single, low-lying, momentum state. In general, the excitation operator μ_k^+ is shown to be of the form used by Feynman and Cohen (FC) in their work on He II, while at low momenta, it reduces to the density fluctuation operator. Furthermore, in the weak coupling limit, μ_k^+ is identical to that of Bogoliubov. A relation between the excitation spectrum derived by Feynman and that found here is established. The liquid structure factor is then calculated and is shown to yield the standard result at low momenta. The f-sum rule is also derived. Author

N66-10269# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON COMPOSITE MODEL OF BARYONS ON THE BASIS OF THREE-BODY EQUATION [O SOSTAVNOY MODELI BARYONOV NA OSNOVE URAVNENIYA DLYA TREKH CHASTITS]
P. N. Bogolyubov 1965 17 p refs In RUSSIAN
(P-2186) CFSTI: HC $1.00/MF $0.50

The three-body equation was treated in the following cases: (1) when the electromagnetic field is absent: and (2) when a weak electromagnetic field is present. Author (NSA)

N66-10270# Princeton-Pennsylvania Accelerator, Princeton N. J.
OFF-LINE GLOBAL APPROACH TO PATTERN RECOGNITION FOR BUBBLE CHAMBER PICTURES
M. J. Bazin and J. W. Benoit 19 May 1965 9 p Submitted for Publication
(Contract AT(30-1)-2137)
(PPAD-2137-548)

A method is described for the automatic processing of bubble chamber film which strives directly for a pattern recognition system using an off-line treatment of the data by global methods. R.N.A.

N66-10272# Oak Ridge National Lab., Tenn.
INFORMATION ON CONVERSION COEFFICIENTS FROM COULOMB EXCITATION AND LIFE-TIME MEASUREMENTS
P. H. Stelson [1965] 14 p refs Presented at the Intern. Conf. on the Internal Conversion Process, Vanderbilt Univ., Nashville, Tenn., 10–13 May 1965
(Contract W-7405-ENG-26)
(ORNL-P-1419; CONF-650525-5)

A review of all the available information on total E2 conversion coefficients for even-even $2+ \rightarrow 0$ transitions for rare-earth and very heavy nuclei is presented. Tables of conversion coefficient data, both experimental and theoretical, are presented. NSA

N66-10273# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
ENERGY TRANSFER BY NEUTRONS TO CERTAIN MATERIALS
W. H. Buckalew [1965] 7 p refs
(Contract AT(29-1)-789)
(SC-DC-65-1544; CONF-650707-2)

Computations were made of the energy absorbed in several elements from interactions with neutrons in the energy range of 0 to 14 Mev. In these calculations the results were normalized to one neutron per square centimeter per gram of target material, thus making it easier to calculate energy absorbed in compounds containing these elements. Results are presented graphically for the elements hydrogen, carbon, nitrogen, oxygen, aluminum, silicon, germanium, tantalum, and bismuth. The energy transfer for two excitation energy assumptions in inelastic scattering are also presented. It was concluded that the energy absorption properties of any one element may not be inferred from the energy absorption properties of some other material. Regarding inelastic scattering, it is preferable to use the second approximation for the excitation energy, since this implies that the scattered neutron is of very low energy. The lack of information on the angular distribution of the recoil particle, in the (n, charged particle) reactions, leads to some error in the energy imparted to the recoil nuclei, but is of little consequence when considering the total energy deposited. R.N.A.

N66-10275# Columbia Univ., Irvington, N. Y. Nevis Lab.
ANTIPROTON ANNIHILATION IN HYDROGEN AT REST. PART I: REACTION $\bar{p} + p \rightarrow K + K^* + \pi$
N. Barash, P. Franzini, L. Kirsch, D. Miller, J. Steinberger (Columbia Univ., N. Y.) et al May 1965 17 p refs
(Contract AT(30-1)-1932; Grant NSF GP-1250)
(R-501; CU-239; NEVIS-133)

In a study of 735 000 antiproton annihilations at rest in the hydrogen bubble chamber 182 examples of the reaction $K_1K_1\pi^0$ and 851 examples of the reactions $K_1K^\pm\pi^\mp$ were recorded. The distributions in the internal variables of these reactions are presented. A substantial fraction of the latter reaction proceeds through an intermediate K^* state; $p + p \rightarrow K + K^*$. The theory of the interference effects in this reaction is presented and compared with the experimental result. It is concluded that the KK^* annihilation proceeds dominantly from the ^3S, I = 1 state of the $\bar{N}N$ system. The fraction of $\bar{p}p$ annihilations into KK^* is given as $f_{KK^*} = (2.1 \pm 0.3) \times 10^{-3}$. Author

N66-10349# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
LIMITED-ENERGY NEUTRON SOURCES PRODUCED BY THE DECAY OF EXCITED NUCLEI
E. A. King Sep. 1965 62 p refs
(Contract AT(10-1)-205)
(IDO-17115)

Three phenomena are considered as sources of neutrons. These are: (1) Radionuclide delayed neutron emission—Nitrogen-17 and fission product delayed neutron precursors are considered and several systems for their use in MTR are proposed. (2) Photo-neutron reactions—Radionuclide gamma ray bombardment of beryllium and deuterium is reviewed. Several reactions not previously considered in the literature are included. Neutron-capture gamma rays are considered as gamma ray sources Several (n, γ) and (γ,n) targets are considered. Systems for their use in MTR are proposed. (3) Alpha-neutron reactions—Reactions using alpha particles emitted from radionuclides are considered as sources. Some usable radionuclide alpha particle sources are listed, nuclides with usable reaction thresholds are tabulated, and a bibliography of alpha-neutron sources is included. Author

N66-10440# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
MEASUREMENT OF FAST FISSION RATIOS IN NATURAL URANIUM
C. B. Bigham Aug. 1965 93 p refs
(AECL-2285; CRRP-1220) CFSTI: HC $3.00/MF $0.75

Fast fission ratios (U^{238} fissions/U^{235} fissions) have been measured to an accuracy of ±2% or better for natural uranium metal, UO_2 and UC single rods and for a series of natural uranium–D_2O lattices. The measurements were made by the well known fission products γ-ray counting technique with a double fission chamber calibration. The accuracy of this calibration and the corrections made for neutron self-shielding, γ-ray self-shielding, gap effect and interaction effect are discussed in some detail. The results are compared with earlier measurement and with theoretical calculations. The experimental results cover a sufficiently wide range to show that current theoretical treatments are sufficiently accurate for analyses of most of the natural uranium–D_2O lattices of interest. Author

N66-10442# Adelaide Univ. (Australia). Dept. of Physics.
MOLECULAR OXYGEN PHOTO-ABSORPTION CROSS SECTIONS BETWEEN 1050 Å AND 2350 Å
A. J. Blake, J. H. Carver, and G. N. Haddad Aug. 1965 24 p refs
CFSTI: HC $1.00/MF $0.50

Photoelectric methods employing a variety of detectors have been used to determine the photo-absorption cross sections of molecular oxygen in the range 1050–2350 Å. Significant departures from Beer's law have been observed in a number of wavelength regions. In the Schumann-Runge bands apparent cross sections determined using Beer's law are found to vary inversely as the square root of the layer thickness of the absorbing gas. Author

N66-10447# IIT Research Inst., Chicago, Ill.
TRAJECTORY ANALYSIS FOR STRUCTURAL FRAGMENTS
Edward B. Ahlers 1 Aug. 1965 103 p Addendum to "Debris Clearance Study", Final Rept., Sep. 1963
(Contract OCD-OS-62-202)
(SRM-65-1)

A trajectory analysis for structural fragments subject to blast winds from nuclear bursts and a compilation of computed trajectories are presented. Trajectories are analyzed on the following basis: Total trajectory time is considered to be free-fall time of drop from initial fragment height. Drag in vertical direction is neglected. Blast winds are considered effective for total trajectory time. Negative phase winds are included in the analysis. Trajectories are computed for spherical masonry fragments yielding results for certain values of effective aerodynamic coefficients. Effects of orientation and rotation on the effective aerodynamic coefficients for angularly shaped objects are not included. Compilations of fragment trajectories are included which cover the following range of parameters: masonry fragments from 2-inch diameter to 24-inch diameter, initial fragment elevations from grade to 280 feet above grade, nuclear weapon yields 100 kilotons to 50 megatons, and initial structure ground ranges corresponding to peak overpressure regions from about 7 to about 250 psi. R.N.A.

N66-10450# United Kingdom Atomic Energy Authority, Harwell (England).
ON THE EXCITATION OF ATOMS OF ALKALI METALS
L. Vainshtein, V. Opykhtin, and L. Presnyakov Oct. 1964 11 p refs Transl. into ENGLISH from Tr. Fiz. Inst., Akad. Nauk SSSR, Rept. A-53, 1964
(AERE-TRANS-1018) CFSTI: HC $1.00/MF $0.50

The model developed in an earlier publication was generalized for application to any atom. On the basis of both this model and the close coupling method, the excitation of alkali metal atoms by collision with electrons is considered. For non-resonance levels, excitation near the threshold proceeds mainly through an intermediate level. When $E < 3\Delta E$ (and for all E values, in the case of resonance levels), the model agrees well with the excitation cross section. Author (NSA)

N66-10451# Joint Inst. for Nuclear Research, Dubna (USSR).
REACTIONS OF NEUTRONS WITH URANIUM-235 NUCLEI AT 0.002 TO 30 KEV
Thih-Ti-Wang, Yung-Chang Wang et al 1965 15 p refs In RUSSIAN
(JINR-P-2024; CONF-650301-35) CFSTI: HC $1.00/MF $0.50

Level parameters, mean fission cross sections, and radiative capture in neutron reactions with ^{235}U nuclei at 0.002 to 3 kev were measured by a time-of-flight method using pulsed fast reactor as a resonance neutron source. A 2048-channel analyzer with channel width 32, 16 and 8 μsec was used for recording energy intervals at 0.002 to 0.005, 0.005 to 1.5, and 1.5 to 30 kev, respectively, resulting in a resolution of $\Delta t/L = 0.04$ μsec/m. NSA

N66-10453# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
PREPARATION OF GERMANIUM γ-SPECTROMETERS BY LITHIUM-DRIFT METHOD [POLUCHENIYE GERMANIYEVYKH SPEKTROMETROV γ IZLUCHENIYA PO METODU DREIFA IONOV LITIYA]
M. Dakovski, V. Pshiborski, M. Sventchak, M. Sovinski, and Ya. Khvashschevska Dec. 1964 10 p refs In RUSSIAN
(INR-592(II)PL) CFSTI: HC $1.00/MF $0.50

Germanium diodes for γ-ray spectrometry using the lithium-ion drift technique and p-type germanium have been fabricated. Active depths up to 1.5 mm were obtained. The γ-spectrum of source radioactive elements using these detectors (working at 90° K) are presented. The resolution for ^{181}Hf(γ-energy of 615 kev) is 7.2 kev and for ^{60}Co(γ-line of 133 kev) is 12 kev. Author (NSA)

N66-10454# International Center for Theoretical Physics, Trieste (Italy).
POSITON AND NEGATON PLANE WAVES
I. Saavedra (Chile Univ.) Apr. 1965 13 p refs Submitted for Publication
(IC-65-38) CFSTI: HC $1.00/MF $0.50

Starting from the solutions of the Dirac equation in the rest system ($\vec{p} = 0$) of the electron, the plane wave solutions in the system in which the electron momentum is $\vec{p} \neq 0$ are constructed under the assumption that the Dirac equation describes two kinds of particles, with positive and negative masses, respectively. It is then shown that these two types of solutions are related to each other through the usual definition of charge conjugation, i.e., that one describes negatons whereas the other describes positons. Author

N66-10455# International Center for Theoretical Physics, Trieste (Italy).
PROPER TIME FORMULATION OF THE ELECTRON THEORY II: ELECTROMAGNETIC INTERACTIONS AND CONSTANTS OF MOTION
I. Saavedra Apr. 1965 12 p refs Submitted for Publication
(IC-65-43) CFSTI: HC $1.00/MF $0.50

Two problems are considered in this paper: first, the proper time formalism developed in a previous paper for the

free particle case is extended to include the electromagnetic interaction; and second, the free particle formalism is applied to construct a conserved spin angular momentum operator, whose connection with other spin operators described in the literature is discussed in detail. Author

N66-10456# Massachusetts Inst. of Tech., Cambridge.
PHYSICAL BASIS OF THE OPTICAL MODEL
R. H. Lemmer Aug. 1964 8 p
(Contract AT(30-1)-2098)
(MIT-2098-67; CONF-682-1)

Some physical characteristics of the optical model for nucleon–nucleon and more complex reactions are discussed. Information obtainable about nuclear dynamics from the empirical optical potential is discussed. (NSA)

N66-10465# Massachusetts Inst. of Tech., Cambridge.
A PHOTOPRODUCTION EXPERIMENT USING A SMALL COMPUTER
R. Alvarez, V. Elings, Z. Bar-Yum, D. Garelick, S. Homma et al [1965] 8 p ref Prepared in cooperation with Cambridge Electron Accelerator
(Contract AT(30-1)-2098)
(MIT-2098-125; CONF-650510-1)

An experiment on which a small computer is used to measure the angular distribution of the reaction $\gamma + p \rightarrow \pi^o + p$ at gamma energies of 1 to 6 Bev is described. Descriptions and diagrams are also given of the magnetic spectrometer used to measure the proton angle and momentum and the gamma ray hodoscope for detecting the π^o decay gamma rays. NSA

N66-10467# Argonne National Lab., Ill.
γ-RAYS AT THE CAPTURE AND INELASTIC SCATTERING OF NEUTRONS [GAMMA-LUCHI PRI ZAKHVATE I NEUPRUGOM RASSEYANII NEITRONOV]
V. S. Al'nikov, D. L. Broder, A. I. Lashuk, I. P. Sadokhin, and L. P. Kham'yanov Apr. 1965 7 p refs Transl. into ENGLISH from Russian Submitted for Publication
(ANL-TRANS-178)

Spectra of γ-rays are presented, which originate from the neutron capture at the first resonances of In and Sm. The relative and absolute yields of low-energy γ-rays have been determined and a change of the high energy part of the spectrum at the transition from resonance to resonance has been observed qualitatively. The cross-section of the formation of γ-quanta with an energy up to 6.26 mev on Fe. The excitation cross-sections of five levels of iron have been determined up to 4 mev. The cross-section of the formation of γ-quanta with an energy of 0.92 mev on Zr has been measured up to 3.5 mev; the transitions between the excited levels of Fe^{56} and Ni-nuclei have been determined. Author

N66-10469# International Center for Theoretical Physics, Trieste (Italy).
ON THE MASS FORMULA FOR SU(6)
M. A. Rashid Apr. 1965 6 p refs Submitted for Publication
(IC-65-46) CFSTI: HC $1.00/MF $0.50

Attempts by Kuo and Yao and by Beg and Shingh to write the SU(6) mass formula corresponding to the Gell–Mann–Okubo formula for SU(3) multiplets are reviewed. Clebsch–Gordon coefficients for the group SU(6) are used to write down equations for the masses of the particles for the 35 and 56 representations in terms of the reduced matrix elements; cases of baryons and of mesons with linear and quadratic masses are considered. Various mass formulas are derived, in fair agreement with experiment; it is found that the existence of a bad relation does not necessarily imply a large reduced matrix element, and that large reduced matrix elements do not necessarily mean bad relations. It is concluded that, if the masses of the particles in the 35- and 56-dimensional representations are a guide for a mass relation, and if the mass operator is assumed approximately the same for both of these cases, the only choice is to use linear relations for both and to consider contributions of only 1, 35, 189, and 405. NSA

N66-10470# International Center for Theoretical Physics, Trieste (Italy).
NUCLEON-NUCLEON SCATTERING IN $\tilde{U}(12)$
D. A. Akyeampong, (Imperial Coll., England), R. Delbourgo, and Fayyazuddin 4 May 1965 7 p refs Submitted for Publication
(IC-65-50) CFSTI: HC $1.00/MF $0.50

Baryon-baryon scattering is considered in the context of $\tilde{U}(12)$; studies were limited to the (equal mass) case of nucleon-nucleon scattering because of the computational difficulties in the relativistic problem. It was found that singlet and triplet scattering lengths are equal for the np system, the process $p\bar{p} \rightarrow \bar{p}p$ dominates near threshold over all other scattering involving baryons, and the polarization of outgoing nucleons is not ruled out by $\tilde{U}(12)$. The $B\bar{B}$ scattering amplitudes are derived in $\tilde{U}(12)$ and expressed in the G.G.M.W. form NSA

N66-10502# International Centre for Theoretical Physics, Trieste (Italy).
SYMMETRIES OF STRONG INTERACTIONS
Abdus Salam Oct. 1964 19 p refs Presented at the Intern. Conf. for High Energy Physics, Dubna, USSR, Aug. 1964
(ICTP-64/1; CONF-550-91) CFSTI: HC $1.00/MF $0.50

Four areas of interest are presented that deal with the study of Theoretical Physics. The data mentioned are: (1) the successful tests of SU_3; (2) the composite models of elementary particles based on triplet models; (3) group extensions and super-asymmetries like $SU_3 \times SU_3$; and (4) dynamical considerations. R.W.H.

N66-10504# Oak Ridge National Lab., Tenn.
ON THE RELATIONSHIP OF THE CHARACTERISTIC ENERGY LOSSES TO TEMPERATURE AND SCATTERING ANGLE
G. Meyer [1957] 16 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 148, 1957 p 61–71 In GERMAN and ENGLISH
(ORNL-TR-536)

The relation of the mean energy loss to the object temperature that was measured with Al and Ge by means of the retarding potential method is under study. It was found that the magnitude of this energy loss was independent of the thickness of the foil, of the acceleration potential, and, in the case of more approximate measurements, of the angle of scattering that forms in this inelastic scattering process. Recently, it was found that an increase of the energy loss with angle exists within small angles of scattering. Also noted was that multiples of the energy loss occurred with larger layer thickness, and that the frequency of the various multiples represents a Poisson distribution. The angular distribution of the electrons after an inelastic collision was investigated by means of the retarding potential method, and it was found that its width decreases with an increasing acceleration potential. R.W.H.

N66-10514# Oak Ridge National Lab., Tenn.
PROGRAMS TO CALCULATE THE LATTICE VIBRATION FREQUENCY SPECTRUM OF GRAPHITE BY THE ROOT-SAMPLING METHOD
J. V. Wilson 28 Oct. 1964 14 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-991)

Two short FORTRAN programs for calculating the lattice vibration frequency spectrum of graphite are presented. These calculate the spectrum for modes in the plane of the hexagon lattice and for modes normal to that plane, using the root-sampling method and the theory of Yoshimori and Kitano. Author (NSA)

N66-10519# Rochester Univ., New York. Dept. of Physics and Astronomy.
ALGEBRA OF CURRENTS AND A LOW ENERGY THEOREM
Susumu Okubo 29 Sep. 1965 19 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-97)

By use of a modified Fubini-Furlan technique, it has been shown that a certain commutation relation among spatially integrated currents gives the low-energy Kroll-Ruderman theorem on the photo-production of a pion by nucleon. Author

N66-10524# Joint Inst. for Nuclear Research, Dubna. (USSR).
ADVANCES IN SPARK CHAMBERS [RAZVITE METODIKI ISKROVYKH KAMER]
A. A. Tyapkin 1964 13 p refs In RUSSIAN
(JINR-P-1810; CONF-550-75) CFSTI: HC $1.00/MF $0.50

A review is given of the performance and improvement of spark and gas discharge chambers. The treatment of spark chamber films and filmless techniques for spark chamber data are discussed as well as some optical methods of recording spark coordinates. The enumerated recordings of the spark position by sonic, electric, or optical processes are not suitable for recording traces of several particles and may be used only for measuring particle polarization. The conclusion was made that the photographic methods are the most efficient recording methods. (NSA)

N66-10527# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
AN ATTEMPT OF DETERMINING THE PARITY OF THE GROUND STATE OF PU-239 [POPYTKA OPREDELENIYA CHETNOSTI OSNOVNOGO SOSTOYENIYA PU-239]
Yu. A. Aleksandrov, Yu. V. Ryabov, and G. S. Samosvat 1965 8 p refs In RUSSIAN
(JINR-P-2014) CFSTI: HC $1.00/MF $0.50

The results of measurements of the gamma ray spectra produced in the capture of neutrons in the resonances of ^{239}Pu with 0 and 1 in the energy range 0.3 to 24 ev are given. An attempt is made to determine the parity of the ground state of ^{239}Pu by comparing these spectra. Author (NSA)

N66-10529# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
A LOGARITHMIC POTENTIAL (b/x ^{2}ln x) IN THE THEORY OF G ϕ4 [LOGARIFMICHESKII POTENTSIAL (b/x ^{2}LN x) V TEORII g ϕ4]
A. N. Tabachenko 1965 7 p refs In RUSSIAN
(JINR-P-2073) CFSTI: HC $1.00/MF $0.50

The analytic properties of the scattering amplitude as a function of the coupling constant g and the angular momentum λ are treated in the theory $g\phi^4$. It is found that for the potential (b/x ^{2}ln x) the amplitude is analytic in g at the point g = 0 and has a logarithmic branch point at λ = 0. Author (NSA)

N66-10536# Brookhaven National Lab., Upton, N. Y. Sigma Center.
NEUTRON CROSS SECTIONS. VOLUME III: Z = 88 TO 98
John R. Stehn, Murrey D. Goldberg, Renate Wiener-Chasman, Said F. Mughaghab, Benjamin A. Magurno et al Feb. 1965 263 p refs
(BNL-325, 2d Ed., Suppl. 2) CFSTI: $3.00

The present supplement of new measurements of neutron cross sections supersedes previous issues only when there is new information or new interpretations of old information It includes and refers to all experimental data on thermal cross sections, resonance parameters, and cross section curves for elements or isotopes with atomic numbers 88 to 98. G.G.

N66-10543# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
THE OFF-SHELL STRUCTURE OF THE PARTIAL T-MATRIX IN POTENTIAL SCATTERING
J. Y. Guennéguès Sep. 1965 27 p refs
(TH/108) CFSTI: HC $2.00/MF $0.50

For the usual superpositions of Yukawa potentials, we express the partial off-shell two-particle T-matrix $T_l(k,k',p)$ in terms of the solutions of the Schrödinger equation and study its analytic properties with respect to the energy (p) and the initial (k) and final (k') momenta. T_l is shown to be equal to a meromorphic term, separable in k and k', plus a nonseparable but analytic part containing the Born approximation. For this purpose, we make use of a *non-singular* integral equation deduced from the operational form of the Lippmann-Schwinger equation, by taking its matrix elements between a ket of the momentum representation and a bra of the coordinate representation. Author

N66-10547# Joint Inst. for Nuclear Research, Dubna (USSR).
A STUDY OF SECONDARY REACTIONS IN BOMBARDING COPPER BY 140–660 MEV PROTONS [ZUCHENIE VTORICHIYKH REAKTSII PRI BOMBARDIROVKE MEDI PROTONAMI S ENERGEI 140–600 Mev]
V. H. Mekhedov, V. N. Rybakov, N. S. Mal'tseva, S. P. Makarov, and Ch'uan-P'eng Wang

Using radiochemical methods, new data were obtained on the production cross sections of Ga, Ge, As, Se, and ^{67}Cu isotopes when bombarding natural Cu by 140- to 660-Mev protons. Author (NSA)

N66-10555# Argonne National Lab., Ill. Reactor Physics Div.
COMPILATION OF REQUESTS FOR NUCLEAR CROSS SECTION MEASUREMENTS
A. B Smith, comp. Aug. 1965 91 p
(WASH-1057) CFSTI: $3.00

Requests for neutron cross section measurements are tabulated and the procedures for requesting information on these measurements are outlined. E.E.B.

N66-10596# Comitato Nazionale per L'Energia Nucleare, Frascati (Italy).
CALCULATION OF A NUCLEONIC CASCADE IN ALUMINUM WITH THE MONTE CARLO METHOD FOR ENERGIES BETWEEN 400 AND 30 MEV [CALCOLO DI UNA CASCATA NUCLEONICA IN ALLUMINIO CON IL METODO DI MONTE CARLO PER ENERGIE TRA 400 E 30 MeV]

M. A. Locci, P. Picchi, and G. Verri 6 Sep. 1965 22 p refs In ITALIAN *Its* Nota Interna No. 287
(LNF-65/30) CFSTI: HC $1.00/MF $0.50

A nucleonic cascade generated by primary nucleons with energy mass of 400 MeV was calculated for aluminum using a Fortran program and an IBM 7040 computer. A Monte Carlo method was employed, and two types of calculations are presented: those concerning cascades generated by secondary spectrum energy distribution, and those generated by a monochromatic neutron beam. Transl. by G.A.L.

N66-10598# Nihon Univ., Tokyo (Japan). Dept. of Physics.
UNIFICATION OF TWO-BODY INTERACTION OF NON-LEPTONIC DECAY AND MASS-SPLITTINGS ON THE BASIS OF CABIBBO SPACE INVARIANCE
Mitsuo Imoto, Shin-ya Furui (Ibaraki Univ.), and Shoichiro Kawasaki (Chiba Univ.) [1965] 6 p refs
(NUP-65-12) CFSTI: HC $1.00/MF $0.50

The non-leptonic decay Hamiltonian of handrons seems closer to mass-splitting terms than the leptonic decay interaction of the $J^{+}J$ type. Moreover, non-leptonic decay Hamiltonians and mass-splitting are not merely SU(3)-breaking but also are described with very close tensor elements belonging to the same eight-dimensional representation. These factors are taken into account in the proposal that these SU(3)-breaking terms should be so unified that they as a whole form an invariant in a special subspace defined by Cabibbo conditions on leptonic decay. E.E.B.

N66-10621# Comitato Nazionale per l'Engergia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
THE TRANSVERSE RESISTIVE WALL INSTABILITY OF EXTREMELY RELATIVISTIC BEAMS OF ELECTRONS AND POSITRONS
E. Ferlenghi, C. Pellegrini, and B. Touschek 30 Aug. 1965 23 p refs *Its* Nota Interna No. 286
(LNF-65/27) CFSTI: HC $1.00/MF $0.50

A brief account is given of the physical principles underlying the transverse instability of high energy beams. Agreeing that the transverse instability is due to the finite resistivity of the acceleration chamber walls, and that it can be remedied either by the application of a feedback or by the introduction of nonlinearities which inhibit the buildup of large amplitudes of betatron oscillations, this report gives a description of a relevant part of this type research. It concentrates on the exchange of longitudinal and transverse energy which is allowed by the interaction between the electron and the force resulting from the finite conductivity of the wall. A method is outlined for treating the problem which leads to the calculation of the risetime for a continuous beam, the obtaining of a risetime for an extremely bunched beam, the risetime for an arbitrary number of bunches, an to the calculation of the resistive wall risetime for the interaction between an arbitrary number of infinitely short bunches of electrons and positrons. C.L.W.

N66-10667*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTIMUM TARGET ORIENTATION IN NUCLEAR REACTION EXPERIMENTS
John L. Need Washington, NASA, Nov. 1965 26 p refs
(NASA-TN-D-3116) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The conditions are examined under which the energy spread in outgoing particles from a nuclear reaction due to finite target thickness is minimized. Physical restrictions on the angle of incidence and emission are explicitly considered, and it is shown that the minimum in energy spread does not always occur at the limits. Targets are considered both in transmission and in reflection. A FORTRAN IV program embodying these results is described. The program determines the optimum target angle for each of a sequence of angles of observation and calculates the energy spread. Author

N66-10674*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THEORY OF LOW-ENERGY POSITRON-HELIUM SCATTERING
Richard J. Drachman Nov. 1965 21 p refs
(NASA-TM-X-55301: X-641-65-460) HC $1.00 CFSTI: /MF $0.50 CSCL 20H

A modified adiabatic method, previously tested in positron-hydrogen scattering, has been applied to the case of positron-helium scattering below the positronium threshold (17.8 ev). Since the ratio of the positron's velocity to that of the atomic electrons is about the same as in the hydrogen test case, similar accuracy is expected, the main source of error being due to the approximate atomic wave function used. Phase shifts for L = 0,1,2 are presented, and total and momentum-transfer cross-sections are computed. The latter disagree completely with the only experiments performed to date. Author

N66-10679# Phillips Petroleum Co., Idaho Falls, Idaho.
CEP, A MONTE CARLO PROGRAM FOR THE CALCULATION OF FIRST-FLIGHT ESCAPE PROBABILITIES FOR FINITE CYLINDERS
W. K. Foell, C. W. Berner, and S. Tong Sep. 1965 22 p refs
(Contract AT(10-1)-205)
(IDO-17075) CFSTI: $1.00

Cylinder Escape Probability (CEP) is a Monte Carlo Program for computing the first-flight escape probability of neutrons from finite cylinders, written in the MAP language for the IBM 7040 computer. Either one cylinder or two concentric cylinders (of which the inner may be empty) of the same height may be used. Each cylinder is subdivided into smaller cylindrical volumes, or cells, for the purpose of a uniform neutron source distribution. There is a provision for reading in a non-uniform source distribution, or weight, as a function of radius and height for each cell. A representative particle from each cell is followed along randomly generated direction cosines until it escapes from the system, producing a probability of escape for the particle in that cell. The sum of the resulting probabilities, weight-averaged over all the cells, yields the total neutron escape probability for the cylinder(s). The Student-t statistical analysis is computed for the probability of escape in each problem. Typical results are given, including a comparison with escape probabilities obtained from average chord length considerations. Author

N66-10697# Atomic Energy Establishment, Winfrith (England). Technical Assessments and Services Div.
G.M.S.I.: A GENERALIZED MULTIGROUP SYSTEM OF CALCULATIONS USING THE IBM 7030 (STRETCH) COMPUTER
C. P. Gratton and P. E. Smith Feb. 1965 17 p refs
(AEEW-M-458) CFSTI: HC $1.00/MF $0.50

A generalized system of reactor physics calculations is described. Written in Fortran for the IBM 7030 computer, the program will perform cell, supercell, and overall reactor physics problems within the limits of one dimension, using either slab or cylindrical geometry. Program input was simplified, and extensive edit facilities were incorporated to permit better understanding of the multigroup output. Program logic is written in terms of 40 neutron energy groups, with the group

boundaries selected by the user. Details are given on the methods used and problem size limitations; macroscopic data preparation; geometrical representation; flux distribution; edit and output facility; cell averaging and evaluation of material buckling; and the burn-up calculation. The 40-group structure of the thermal reactor library file is enumerated in detail, and input data specifications are summarized. M.G.J.

N66-10719# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems

ATOMIC CAPTURE OF NEGATIVE MUONS IN CHEMICAL COMPOUNDS

V. G. Zinov, A. D. Konin, and A. I. Mukhin 1965 13 p refs In RUSSIAN

(JINR-P-2185) CFSTI: HC $1.00/MF $0.50

Atomic capture of negative muons is considered for a large number of oxides and salts. Overall results are tabulated, and graphs are included to illustrate relative values.

Transl. by M.W.R.

N66-10723# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

MEASURING THE DOSE RATES FROM NEUTRON RADIATION OVER A BROAD ENERGY SPECTRUM

N. A. Golovanov, N. M. Kozodaeva, B. A. Korotin, and G. K. Popkov [1965] 8 p refs Transl. into ENGLISH from Rept. No. 74, State Comm. on the Use of Atomic Energy USSR (Moscow)

(AEC-TR-6590)

Two methods of making neutron detectors with dosimetric characteristics covering the energy range from 0.025 eV to 20 MeV are described. The first method is based on using a moderator of thickness which ensures the dosimetric nature of the shape of the sensitivity curve. The second method is based on utilizing the energy sensitivity characteristics of neutron detectors. A specific sensitivity ratio between fast and intermediate neutron detectors gives a satisfactory approximation of the dosimetric curve. Advantages and disadvantages of both methods are cited. It is concluded that the scintillation method may be used to develop detectors for portable, mobile, and stationary group control devices with a lower sensitivity limit of the order of 0.3 mrem/hr. Should measurements of lower radiation dose rates be required, isodose counters based on the moderator method may be used. In this case the lower limit of measurement will be of the order of 0.005 mrem/hr. C.T.C.

N66-10740# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

TOPICS IN NUCLEAR REACTOR THEORY

A. W. Solbrig, Jr. Sep. 1965 37 p refs

(Contract AT(10-1)-205)

(IDO-17120) CFSTI: $2.00

This paper contains derivations, including some novel features, of several known results. The principal known results are: (1) formulas for Doppler broadening of neutron cross sections by motion of target nuclei; (2) the P-1 approximation to the Boltzmann equation for neutron transport; and (3) a relation between the neutron scattering cross sections for a free nucleus and for an identical nucleus bound in a molecule. Appendixes contain a derivation of a property of the Doppler broadening integral, proofs of a lemma used in deriving the P-1 equations without spherical harmonics, and some remarks about derivation of a form of the B-1 equations. Author

N66-10744# Instituto de Energia Atomica, Sao Paulo (Brazil).

I.E.A. NEUTRON VELOCITY SELECTOR THEORY AND CALIBRATION

F. G. Bianchini, M. Abreu, L. Q. Amaral, and O. W. Martins Nov. 1964 15 p refs Presented at the Study Group Meeting on the Util. of Res. Reactors Sponsored by the Intern. Atomic Energy Agency, Sao Paulo, Brazil, Nov. 1963

(IEA-78) CFSTI: HC $1.00/MF $0.50

A mechanical velocity selector (MVS) with helical channels, for the monochromatization of slow neutrons was constructed. The channel rotation velocity determines the emergent neutron energy. This instrument is used as a low resolution monochromator and as a filter for higher order neutrons reflected by crystals. The average wavelength of the MVS was compared with the ideal MVS wavelength and a relationship between them was established. The transmission function of the selector was also determined. The experimental verification of the calculated wavelengths was made by analyzing the emergent spectrum of the selector with the crystal spectrometer. The gold cross-section measured with the neutron spectrometer coupled to the velocity selector showed its use for the elimination of the effects due to the high order reflections. R.W.H.

N66-10767# Illinois Univ., Urbana. Coordinated Science Lab.

GROUND STATE OCCUPATION PROBABILITIES FOR OPTICALLY PUMPED ALKALI METAL ATOMS

Frank A. Franz Aug. 1965 66 p refs

(Contract DA-28-043-AMC-00073(E))

(R-265; AD-620249)

The purpose of the report is to present calculations of the relative populations of the ground state Zeeman sublevels of an optically pumped alkali atom. Two modes of optical pumping–zero mixing and complete mixing in the excited state–and three modes of alkali relaxation–uniform, Zeeman, and electron randomization–are considered. Calculations of the sublevel relative populations for an alkali atom of nuclear spin 3/2 are then made in terms of experimentally measurable parameters for all six combinations of pumping and relaxation modes. The numerical results are summarized in tables as functions of pumping and relaxation rates. Author (TAB)

N66-10799# Harvard Coll. Observatory, Cambridge, Mass.

RADIATIVE TRANSFER IN LINES FOR MEDIA IN STATISTICAL EQUILIBRIUM Scientific Report No. 2

Wolfgang Kalkofen 25 Jun. 1965 31 p refs

(Contract AF 19(628)-3877)

(AFCRL-65-347; AD-621364)

The line transfer problem is discussed for a two-level atom and extended to an N-level atom. For N = 2 the source function is obtained, and nonlinear and linear integro-differential equations are derived expressing the transfer problem subject to the condition of statistical equilibrium. From the differential equation the corresponding integral equations for the line source function are determined, and the integral kernels are discussed for the case of depth-dependent absorption profiles. The line components of the source function are derived for an N-level atom. The corresponding coupled integral equations for the resonance line components of the source function are discussed for the limit of low temperatures, and a method of solution is outlined. An analytic solution is obtained for the case of constant coefficients and integral kernels which are single exponential functions. Author (TAB)

N66-10814# Maryland Univ., College Park. Dept. of Physics and Astronomy.

ELECTRON-PHONON RENORMALIZATION EFFECTS IN HIGH MAGNETIC FIELDS. THE DE HAAS-VAN ALPHEN EFFECT Technical Report No. 443

M. Fowler and R. E. Prange 10 Mar. 1965 25 p refs
(Grant AF-AFOSR-735-65)
(AFOSR-65-1192; AD-620189)

When a metal is placed in a sufficiently strong magnetic field, it is to be expected that the effective mass of the electrons due to electron phonon interactions will be modified. The condition that the field will be strong enough to have an effect is that the cyclotron frequency be comparable to phonon frequencies. It is expected that such effects may be observable with experimentally realizable fields in some special cases. The amplitude dependence of the de Haas-van Alphen effect was calculated as a function of temperature and magnetic field. This amplitude can be interpreted as giving a field dependent effective mass. The amplitude was calculated numerically for several cases of interest. It is found that the field effects are rather smooth and depend most directly on the electron self-energy function for pure imaginary values of the frequency. Author (TAB)

N66-10874# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN AVERAGE-VALUE THEOREM IN THE MOSSBAUER EFFECT
Lu Yen 11 Aug. 1965 7 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 18, no. 9, 1962 p 483–485
(FTD-TT-65-599/1+2+3+4; AD-619487)

It is proved that the average value of any physical quantity of a crystal after the recoil of resonance scattered photons may be obtained directly from the corresponding average value before recoil merely by changing the momentum operator p of the recoiling nucleus to pthk. The average energy of recoil acquired by a crystal and its mean square deviation are calculated. TAB

N66-10935# Oak Ridge National Lab., Tenn.
GAMMONE-PROGRAM FOR GAMMA-RAY ATTENUATION THROUGH MULTILAYER COMPOSITE SHIELDS. PART 1: MATHEMATICAL BASES OF THE PROGRAM. PART 2: CODING OF THE PROGRAM
L. Criscuolo and M. G. Cerisola [1965] 64 p Transl. into ENGLISH from a rept. prepared by FIAT S.p.A., Turin, and Comitato Nazl. per l'Energia Nucl., Rome
(ORNL-TR-598)

Physical and mathematical bases of the Gammone (Gamma Monte Carlo) program, which is an IBM-704 code which applies in a source-shield configuration, are described. A multilayer composite rectangular parallelepiped shield was studied. The gamma source has different shapes: point, line, infinite plane, and disk. Several techniques, such as importance sampling, are used for increasing the efficiency of a Monte Carlo calculation. The outputs of the code are energy and dose attenuation and build-up through the shield, as well as energy and dose reflection probability at the source-shield interface. Results obtained from the code were in agreement with results from previously reported studies. Included is the Fortran listing of the main program and the seven subroutines, a brief explanation of the use of such subroutines, typical outputs, and a description of the input formats. S.C.W.

N66-10943# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aerospace Research Labs.
ATOMIC WAVE FUNCTIONS, COLLISION CROSS-SECTIONS, AND TRANSITION PROBABILITIES OF Fe IONS
T. K. Krueger and S. J. Czyzak London, Roy. Astron. Soc., 1965 38 p refs *In* Mem. Roy. Astron. Soc., v. 69, pt. 4, 1965 p 144–182 CFSTI: HC $2.00/MF $0.50

Since atomic wave functions of Fe ions are of astrophysical importance, many of these (Fe V–Fe XVII) have been calculated by employing the Hartree–Fock self-consistent field method with exchange. Wave functions, $\epsilon_{\alpha\sigma}$, $\bar{r}$, $\bar{r}^2$, and σ are supplied in tabular form. Probabilities have been calculated for forbidden transitions in Fe X, XI, XIII, XIV and XV, some of which are observed in the solar corona; also the energy levels and forbidden transition probabilities for Fe XII have been estimated. Preliminary cross-section calculations, involving only *p*-waves, for forbidden transitions in Fe XI, XII and XIII have been made and the problems involved in these calculations are discussed. For allowed transitions in Fe XV and Fe XVI probabilities have been calculated and collision cross-sections for the latter ion only. The calculated results presented in this paper are discussed in some detail. Author

N66-10944# Oregon State Univ., Corvallis.
A FORMALISM FOR DIRECT INELASTIC SCATTERING AND CHARGE EXCHANGE
V. A. Madsen [1965] 54 p refs Supported in part by AEC

A general formulation of the direct inelastic scattering problem is presented. It is applicable to collisions between a nuclear projectile having mass number ≤ 4 and any target nucleus for which a shell model description can be given. The interaction is taken to be the sum over nucleon pairs of a central potential with arbitrary spin-isospin mixture. Expressions for the differential cross section are given in terms of spectroscopic amplitudes, which contain all detailed information about the structure of both projectile and target nucleus. Explicit expressions for the spectroscopic amplitudes are given in terms of the nuclear wave functions. Author

N66-10959*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
RELATIVISTIC INTERMOLECULAR FORCES
William J. Meath 2 Apr. 1965 116 p refs
(Grant NsG-275-62)
(NASA-CR-67914; WIS-TCI-75) CFSTI: HC $4.00/MF $0.75 CSCL 20J

The generalized Breit-Pauli Hamiltonian is used to give a systematic treatment of magnetic and other relativistic intermolecular energies through $O(\alpha^2)$ (where α is the fine structure constant) for intermolecular separations, R, sufficiently large that the charge distributions of the two molecules do not overlap and yet not large enough to involve retardation effects. The theory is discussed in general and many interesting types of interaction energies are obtained. These energies depend upon the spin and orbital angular momentum states of the interacting molecules. The interaction of two neutral non-degenerate atoms (with zero spin and orbital angular momentum quantum numbers) is considered as an example of the general theory. It is shown that the interaction energy has a term varying as α^2/R^4 which is of longer range than the usual London dispersion energy and which may be significant in low energy atomic scattering problems. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N66-10001# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PLASMA PHYSICS AND PROBLEMS OF CONTROLLED THERMONUCLEAR FUSION, NO. 3 Collection of Articles

9 Jul. 1965 505 p refs Transl. into ENGLISH of "Fizika Plazmy i Problemy Upravlyayemogo Termoyadernogo Sinteza, Vypusk 3" Kiev, Izd. Akad. Nauk Ukr. SSSR, 1963 p 1-367 (FTD-MT-65-31; AD-620051)

Selected articles are presented on plasma physics, magnetohydrodynamics, and plasma diagnostics. For individual titles see N66-10002-N66-10044.

N66-10002 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF OSCILLATIONS OF PLASMA IN QUASIHYDRODYNAMIC APPROXIMATION

A. B. Kitsenko and K. N. Stepanov *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 3-20 refs (See N66-10001 01-25)

Longitudinal oscillations of plasma with an anisotropic distribution function and excitation of magnetohydrodynamic waves in interpenetrating plasma fluxes with anisotropic distribution function of particles are considered. Equations are derived which describe these phenomena and it is shown that plasma resonance in the region of high and low frequencies has identical peculiarities. E.E.B.

N66-10003 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RADIATION OF LOW-FREQUENCY WAVES BY IONS AND ELECTRONS IN MAGNETICALLY ACTIVE PLASMA

V. I. Pakhomov and K. N. Stepanov *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 21-41 refs (See N66-10001 01-25)

The radiation of ionic-cyclotron and magnetohydrodynamic waves from ions and electrons in helical motion in magnetically active plasmas is discussed. Cyclotron radiation of ions having a velocity of the order of the mean thermal velocity of ions of the plasma and Cerenkov radiation from electrons in the region of low frequencies are considered. Intensity of radiation is determined taking into account cyclotron absorption of radiated waves by the plasma ions and Cerenkov absorption of the plasma electrons. Also, the radiating and absorbing ability of plasma and the equilibrium intensity of radiation in the considered regions of frequencies are determined. E.E.B.

N66-10004 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON HIGH-FREQUENCY OSCILLATIONS OF PLASMA IN A MAGNETIC FIELD

V. D. Fedorchenko, V. I. Muratov, and B. N. Rutkevich *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 42-50 ref (See N66-10001 01-25)

Oscillations in electron beams in a longitudinal magnetic field and the important role of plasmas appearing as a result of ionization of residual gases by electrons are discussed. The spectrum of high-frequency oscillations was studied using a mobile electron probe. The magnetic field was created by a solenoid 75 cm long with internal diameter of 12 cm. The electron gun located in the magnetic field created a hollow electron beam 50 cm long and 2 cm in diameter. Energy of the beam varied from 200 to 300 V; the current was 25 to 50 mA. Operating pressure was 1.3×10^{-4} to 1.3×10^{-3} newton/m^2. The spectra of oscillations for a series of pressure values are given. Also, the dependence of amplitude and spectral composition of oscillations on the magnetic field is shown. The amplitude of high-frequency oscillations rapidly increases with increase of the magnetic field. The change in amplitude with distance from the electron gun was also determined. E.E.B.

N66-10005 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF HIGH-FREQUENCY OSCILLATIONS OF PLASMA BY A SOUNDING BEAM

V. D. Fedorchenko, V. I. Muratov, and B. N. Rutkevich *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 51-61 ref (See N66-10001 01-25)

The propagation and amplification of space charge waves in plasmas penetrated by an electron beam are discussed. These waves were investigated under conditions when the plasma is created by the beam itself as a result of ionization of residual gas at a pressure of 1.3×10^{-4} to 1.3×10^{-3} newton/m^2. The experimental apparatus is diagrammed and the dependence of current in the circuit of the collector of the analyzer of the sounding beam on delaying voltage is shown for different energies of injection of the beam. High frequency oscillations are discussed and it is concluded that oscillations of plasmas cause the formation of uncompensated charge. In strong magnetic fields ion oscillations will be suppressed and longitudinal high-frequency oscillations will be fundamentally important. Therefore, it is expected that in a trap with injection of electrons in fairly strong magnetic fields of the order of 1×10^5 amperes/meter the plasma will have a positive potential. E.E.B.

N66-10006 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NONLINEAR EFFECTS DURING PROPAGATION OF SLOW ELECTRO-MAGNETIC WAVES IN A PLASMA WAVEGUIDE

B. I. Ivanov *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 62-75 refs (See N66-10001 01-25)

Nonlinearities in a plasma waveguide are discussed and equations are derived to describe velocity, charge, and mass relationships. The nonlinear distortions of the shape of a sinusoidal signal propagating in a plasma waveguide, phase velocity of wave propagation in a plasma waveguide and determination of the spectral composition of a signal with increase of distance between receiving and transmitting spirals are considered. It is shown that the sinusoidal signal excited in a plasma experiences distortions in the form of a sawtooth signal with steeper leading edge and that nonlinearities decrease with decreasing amplitude of the input signal, with increase in plasma density, and with frequency of oscillations. Also, the determination of plasma density by the shift of the natural frequency of the resonator and the measurement of relatively small frequency shifts are discussed. E.E.B.

N66-10007 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPACE CORRELATION OF FLUCTUATING ELECTRO-MAGNETIC FIELDS IN PLASMA

V. F. Aleksin and K. N. Stepanov *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 76-92 refs (See N66-10001 01-25)

The use of correlation functions for fluctuating electrical and magnetic fields for the investigation of thermal radiation in plasmas, passage of charged particles through plasmas, and scattering of electromagnetic waves is discussed. The space correlation function for electromagnetic fields in anisotropic gyrotropic media is determined for cases where effects caused by space dispersion of the medium is small. It is shown that in the region of transparency, when damping is low, the radius of correlation coincides with the length of damping of the electromagnetic wave. E.E.B.

N66-10008 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE THEORY OF REFLECTION OF ELECTROMAGNETIC WAVES OF PLASMA

I. A. Akhiyezer *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 93–105 refs (See N66-10001 01-25)

The coefficient of incoherent reflection of electromagnetic waves from plasmas is determined taking into account the plasma boundary. Equations are derived for the electric field and for the component of the Poynting vector normal to the boundary. The reflection coefficient of nonpolarized radiation and the reflection of polarized radiation are considered. In the case of small damping of the incident or reflected wave the spectrum of reflected radiation consists of Doppler broadening of the base line and sharp peaks connected with the possibility of propagation in plasma of collective oscillations. The reflection coefficient of electromagnetic waves from plasmas differs only by a normalizing factor from the coefficient of scattering in nonconfined plasmas. Allowance for the plasma boundary leads to the essential distinction of the coefficient of reflection from the scattering coefficient if the frequency of the incident or reflected waves is equal in order to magnitude to the plasma frequency and for all frequencies in the case of glancing incidence or reflection. E.E.B.

N66-10009 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TOWARD A NONLINEAR THEORY OF ION CYCLOTRON RESONANCE

A. N. Kondratenko *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 106–111 refs (See N66-10001 01-25)

The nonlinear theory of cyclotron resonance is considered in connection with the possibility of heating the ion component of plasmas. The hydrodynamic system of equations near ion cyclotron resonance are derived and conditions for resonance are discussed. Second and third harmonics are included and the maximum energy which an ion can obtain is shown to be of the order of several keV on the waveguide axis. E.E.B.

N66-10010 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON ABSORPTION OF HIGH-FREQUENCY ENERGY BY PLASMA NEAR ION CYCLOTRON RESONANCE. I

M. P. Vasil'yev, L. I. Grigor'yeva, V. V. Dolgopolov, B. I. Smerdov, K. N. Stepanov et al *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 112–127 refs (See N66-10001 01-25)

Cyclotron absorption of electromagnetic waves, excited by electric currents, flowing in a coil surrounding a plasma cylinder is considered. The problem of heating plasmas during cyclotron excitation of strongly attenuating-ordinary waves and weakly attenuating-extraordinary waves are discussed and the results of experimental investigations of absorption of high-frequency energy by plasmas in conditions of ion cyclotron resonance are given. Also, the absorption by plasmas of the energy of a high-frequency field created by a system of coils coupled in antiphase by pairs are included. E.E.B.

N66-10011 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABSORPTION OF HIGH-FREQUENCY ENERGY BY PLASMA NEAR ION CYCLOTRON RESONANCE. II

M. V. Brzhechko, M. P. Vasil'yev, L. I. Grigor'yev, V. V. Dolgopolov, A. S. Loginov et al *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 128–138 refs (See N66-10001 01-25)

An experimental investigation of absorption of high-frequency energy by plasmas in conditions of ion cyclotron resonance is reported. An artificial LC-line excited on a high harmonic is proposed as the system for introduction of high-frequency power in the plasma. Such a system possesses the advantage of low input impedance, high power, low voltage, and relatively small longitudinal high-frequency fields. A self-excited oscillator was used as the source of high-frequency power. The plasma was created by a Penning pulse discharge in a magnetic field. Considerable loading of the oscillator by the plasma occurred near the ion cyclotron resonance. Displacement of the maximum load curve from the resonance value of the magnetic field and the shape of this curve were in agreement with the results of theoretical calculations. The dependence of the amplitude of radio-frequency voltage in the line on the magnetic field strength at different times after ignition of discharge are shown. The data indicated great effectiveness of a LC-line as a system for transmission of high-frequency energy from the oscillator to the plasma in ion cyclotron resonance. E.E.B.

N66-10012 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTRODUCTION OF HIGH-FREQUENCY POWER TO PLASMA LOCATED IN A METAL CHAMBER

O. M. Shvets, V. F. Tarasenko, S. S. Ovchinnikov, and V. T. Tolok *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 139–146 refs (See N66-10001 01-25)

The possibility of introducing high-frequency power to a plasma located in a metal chamber and the behavior of a plasma under the influence of this energy are discussed. A revolving plasma in crossed electrical and magnetic fields is obtained in the chamber. High density, high degree of ionization, large retention time, and low ion temperature are achieved in the chamber. The circuitry for the experiment is shown and the voltage–ampere characteristics of the discharge for different magnetic fields are given. It is shown that the use of high-frequency oscillators for creation of dense plasmas in metal chambers with comparatively low high-frequency voltages are possible. Also, the presence of the plasma in the sensitive volume ensures low load impedance and easily introduced high-frequency power can be used for effective generation of waves in plasmas for the purpose of heating the plasma. E.E.B.

N66-10013 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE INTERACTION OF PULSE HEAVY-CURRENT ELECTRON BEAMS WITH PLASMA IN A MAGNETIC FIELD

A. K. Berezin, G. P. Berezina, L. I. Bolotin, Yu. M. Lyapkalo, and Ya. B. Faynberg *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 149–167 refs (See N66-10001 01-25)

Experiments are discussed to show that a heavy-current electron beam moving in plasma in a magnetic field loses a considerable portion of its initial energy. This energy goes to the excitation of oscillations and heating of the plasma by the electron beam. It is shown that 50 to 60% goes to excitation of longitudinal waves of charge density and transverse electromagnetic oscillations which qualitatively coincides with the given theoretical calculations. Amplification factors and maximum resonant frequency are also in satisfactory agreement with calculated data. In the plasma and the electron beam there are excited longitudinal waves of charge density with phase velocities less than the velocity of light in a vacuum and intensities at the end of the region of interaction of 50 to 60 kV/meter. It is also shown that along with deceleration of the basic bunch of electrons of the beam there occurs considerable increase in the energy of a small bunch of electrons. E.E.B.

N66-10014 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COHERENT INTERACTION OF AN ELECTRON BEAM WITH PLASMA

I. F. Kharchenko *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 168–174 refs (See N66-10001 01-25)

Energy losses of an electron beam were measured by an electrostatic cylindrical analyzer and a phase analyzer. The phase analyzer consisted of two resonator reflecting system placed perpendicularly which permitted obtaining on a fluorescent screen a circular scan of the electron beam with a frequency equal to the frequency of modulation. From the angular displacement of the cluster on the circular scan it was possible to judge losses of energy of the electron beam. Revolving power of the analyzers comprised from 0.2 to 0.4% of the initial energy of the beam. The spectra of energies of the electron beam passing through the plasma are given for different plasma densities. The plasma density was measured by a high-frequency double probe. With increase of plasma density there occurs a displacement of the spectra in the direction of lower energy, decrease of beam current, and spectra expansion. During passage through the plasma an electron excites oscillations, the appearing field modulates the beam, and clusters of electrons of less than half the wavelength of the plasma oscillations are formed with a distance between clusters equal to the length of the plasma wave. E.E.B.

N66-10015 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COHERENT INTERACTION OF "RUN-AWAY ELECTRONS" IN A PINCH

V. A. Sunrunenko, Ya. B. Faynberg, V. T. Tolor, Ye. A. Sukhomlin, N. I. Reva et al *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 175–183 refs (See N66-10001 01-25)

Coherent radiation from a plasma of transverse electromagnetic waves excited by a beam of "run-away" electrons was investigated. Experiments were conducted with apparatus consisting of a rectilinear tube made from aluminum 10 cm in diameter and 25 cm long filled with hydrogen under a pressure of 1.3 newton/m^2. At both ends of the tube flat aluminum electrodes were inserted connected to a battery of capacitors for a total capacity of 15 microfarads. The battery was charged to a voltage of 30 to 40 kV. Discharge current through the gas was about 100 kA. The discharge chamber was located in a magnetic field which could be brought to a strength of 1.2 tesla. Diameter of the plasma column was 4 cm. Density of charged particles was 10^{15} to 10^{16} per cc and electron temperature was of the order of several tens of eV. Coherent interaction of the "run-away" electrons with the plasma leading to the development of electromagnetic instabilities in the plasma were revealed. An electromagnetic radiation appeared from the discharge with a frequency close to the plasma frequency. E.E.B.

N66-10016 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

KINETIC INSTABILITY OF PLASMA

A. I. Akhiyezer, G. Ya. Lyubarskiy, and R. V. Polovin *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 187–199 refs (See N66-10001 01-25)

With increase in temperature there is an increase in the mean free path of plasma particles and an increase in the time required for the establishment of equilibrium. Therefore, during investigation of high-temperature plasmas, it is necessary to deal with distribution functions of particles different from equilibrium. Under these conditions there appears the question of stability of such distributions with respect to small oscillations of field and charge density in the plasma. The stability of the distribution function of particles with respect to plasma oscillations was therefore investigated. Equations for stability and instability are considered and the conditions for stability and instability of such plasmas are discussed. E.E.B.

N66-10017 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE QUESTION ABOUT STABILITY OF HIGH-FREQUENCY HEATING OF PLASMA

V. I. Kurilko and V. I. Miroshnichenko *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 200–201 refs (See N66-10001 01-25)

The stability of ion cyclotron waves in plasmas is considered. Considerations are limited to the case of a wave propagating along a constant magnetic field. The dispersion equation for longitudinal oscillations in a plasma across a magnetic field excited by an ion beam is given and the conditions affecting its validity are discussed. The cases of Cerenkov excitation of a plasma by an ion beam and during Doppler excitation are described. Also, during propagation of ion cyclotron waves in a plasma there are developed instabilities with characteristic times which are considerably larger than the period of the high-frequency wave. These instabilities are discussed for high-frequency waves propagating in a plasma. E.E.B.

N66-10018 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF INSTABILITY IN THE CYCLOTRON METHOD OF HEATING OF PLASMA

N. I. Nazarov, A. I. Yermakov, V. T. Tolok, and K. D. Sinel'nikov *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 204–209 refs (See N66-10001 01-25)

One of the causes leading to cessation of temperature rise of plasmas with increase of introduced power is apparently the development of instability which provokes fast disintegration of the plasma. The influence of the level of high-frequency power on heating of a plasma in the region of ionic gyroresonance was therefore investigated. The existence of two sharply differing regimes of plasma behavior was indicated by the introduction of different high-frequency power. Oscillograms are shown which indicate the plasma behavior. It is shown that a decrease of energy introduced into a plasma leads to disrupture of instability. Study of the intensity of spectral lines of hydrogen confirmed anomalous fast disintegration of plasmas at high levels of energy introduced into a plasma. The nature of the observed instability however is not explained. E.E.B.

N66-10019 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONDITIONS OF EVOLUTIONALITY IN USUAL HYDRODYNAMICS AND MAGNETOHYDRODYNAMICS

R. V. Polovin *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 213–227 refs (See N66-10001 01-25)

Conditions of evolutionality in usual hydrodynamics and in magnetohydrodynamics are discussed and evidence is presented to show that certain degenerate shock waves are evolutional. Basic principles, Hugoniot line considerations, Chapman–Jouguet detonation, change in magnetohydrodynamic quantities in waves of different types, degeneracy, Alfven discontinuity, and super-Alfven combustion are considered. E.E.B.

N66-10020 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMODYNAMIC RELATIONS IN A PLASMA

R. V. Polovin and K. P. Cherkasova *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 228–233 refs (See N66-10001 01-25)

The thermodynamic properties of a plasma consisting of charged and neutral particles are discussed. Disregarding kinetic effects, the behavior of a plasma consisting of N sorts of charged and neutral particles is described by the hydrodynamic equations of motion for each of the N components. The significance of the equation is considered and the entropy and heat released per unit volume per unit time is given which includes particle flux heat, thermal conductivity, collision heat, and thermoelectric effects. E.E.B.

N66-10021 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF PROPERTIES OF PLASMA IN CROSSED ELECTRICAL AND MAGNETIC FIELDS

O. M. Shvets, S. S. Ovchinnikov, V. F. Tarasenko, and V. T. Tolok *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 237–243 refs (See N66-10001 01-25)

Investigations were conducted which show that plasmas rotating in crossed electric and magnetic fields possess a series of advantages over plasmas created by other methods. At densities on the order of 10^{15} per cc and high degree of ionization, rotating plasmas are contained for hundreds of microsec. Measured time of containment corresponds well with time of penetration of magnetic fields formed by azimuthal current through a chamber wall. Thus, it is assumed that the time of containment of a plasma under given conditions is basically determined by the time of penetration of a magnetic field through the chamber wall. If this factor is decisive, then the time of penetration of the field can be increased by using two parameters: conductivity of the chamber walls and wall thickness. It is inexpedient to excessively increase the wall thickness since penetration of the field to a considerable depth will weaken the field next to the chamber wall. Conductivity of the material can be increased by cooling the chamber to low temperatures. E.E.B.

N66-10022 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MOTION OF ELECTRONS IN CROSSED ELECTRIC AND SPACE-MODULATED MAGNETIC FIELDS

V. G. Marinin *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 250–258 ref (See N66-10001 01-25)

Calculations and experimental evidence are presented to show that, during the motion of electrons in crossed electrical and space-modulated magnetic fields, resonance interaction of electrons with space-modulated magnetic fields is realized for a different relationship between longitudinal electron velocity and the space-modulation period than in the case when a radial electrical field is absent. This relationship for the case when an electrical field is created by space charge and by a cylindrical capacitor are given. E.E.B.

N66-10023 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PLASMA OF θ-PINCH IN MAGNETIC GRID

Ya. F. Volkov, V. T. Tolok, and S. M. Krivoruchko *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 259–269 refs (See N66-10001 01-25)

Experiments were conducted to clarify the containment ability of the magnetic grid, comparison of stability, and the purity of a plasma of theta pinch with the magnetic field and without the magnetic field. It was concluded from these experiments that the time of existence of a plasma in a field of magnetic grid of given configuration is proportional to the 2/3 power of the magnetic field. Plasmas with density higher than 6×10^{13} per cc existed in the system for 70 microsec at magnetic field strength between conductors of 2.4×10^5 ampere-turns per meter. An impósition of a magnetic field on the theta pinch apparently lowers instability. Losses of particles occur mainly through magnetic slots. Quantity of impurities from the walls in the discharge decreases with growth of the magnetic field. Separation of adsorbed hydrogen from the walls also decreases. E.E.B.

N66-10024 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTS IN COMPRESSION OF PLASMA BY A RAPIDLY INCREASING MAGNETIC FIELD

G. G. Aseyev, V. S. Voytsenya, and V. G. Konovalov *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 270–277 refs (See N66-10001 01-25)

It was shown previously that in the first half-period of a theta-pinch discharge the compressed plasma column is slowly displaced from the axis of the system toward the wall of the discharge tube in the direction of the cut in the magnetic coil. The results of experimental clarification of the causes which lead to such displacement of a plasma column are presented. Also, the influence of non-coaxiality of the discharge tube and magnetic coil on the plasma column displacement in the first half-period was experimentally established. It was shown that the conducting shield decreases the impurities entering into the discharge. A magnetic field which is reverse to an initial external magnetic field can lead to impairment of stability of the plasma column at about the first maximum of the magnetic field compression. E.E.B.

N66-10025 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEASUREMENT OF ANGLE OF TWIST AND ANGLE OF ROTATION OF LINE OF FORCE IN SYSTEM WITH HELICAL MAGNETIC FIELD

B. P. Il'yenko, V. G. Zykov, Ye. M. Lats'ko, and V. T. Tolok *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 278–285 refs (See N66-10001 01-25)

The confinement of a plasma by external magnetic fields is discussed and the experimental investigation of the angle of twist and angle of rotation in systems with helical magnetic fields is described. Experimental measurements are compared with theoretical calculations. It is shown that the experimental values of the angle of twist and the angle of rotation of lines of force in systems with helical magnetic fields were in satisfactory agreement with the theoretical data. Description of the experimental equipment and the parameters used in the measurements are included. E.E.B.

N66-10026 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MAGNETIC FIELD OF HELICAL CURRENTS FLOWING OVER SURFACE OF TORUS

V. F. Aleksin *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 286–294 refs (See N66-10001 01-25)

Calculations of the magnetic fields of helical currents flowing in an infinitely thin conductor composed of a closed helix on the surface of a circular torus are presented. In the case of an N-turn helical winding with alternating direction of current, the magnetic field is found as a result of summation of fields from separate spirals turned relative to the central axis of the torus at an angle of $2\pi/N$. In the stellarator, helical magnetic

fields are superimposed on the confining magnetic fields created by a system of coils. The influence of toroidal configuration on the helical magnetic fields and magnetic surfaces are explored. E.E.B.

N66-10027 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BEHAVIOR OF LINES OF FORCE IN HELICAL MAGNETIC FIELD
V. F. Aleksin *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 295–298 refs (See N66-10001 01-25)

Magnetic intensity lines in helical magnetic field form magnetic surfaces of which some close around magnetic axis and others close around conductors carrying current. Regions filled with magnetic surfaces of different types are separated from each other by a magnetic surface which is called the separatrix. Near the magnetic axis, nonlinear differential equations for the lines of force can be solved either by the method of perturbation theory or by the method of averaging. These solutions, however, become inapplicable near the separatrix. An exact solution of the differential equation for the case important in practice of a three-turn field with cylindrical symmetry is presented. E.E.B.

N66-10028 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF PLASMOIDS WITH HELP OF THERMOCOUPLES
I. I. Demidenko, N. I. Mitina, and V. G. Padalka *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 301–306 refs (See N66-10001 01-25)

The relative energy distribution of plasmoids as a function of distance from the source was investigated. The experimental point fell on a curve which is a quadratic hyperbola. Oscillograms obtained at different distances of the measurement thermocouple from the plasma source are shown. It was observed that in the absence of a magnetic field, clear separation of the plasmoids occurs only near the source. A distance from the source there occurs overlapping of the plasmoids. The passage of the plasmoids through a longitudinal magnetic field was also studied. The topography of the magnetic field is shown together with an oscillogram of the signal from the thermocouple during the imposition of the longitudinal magnetic field. The plasmoids are sharply separated from each other in the absence of a magnetic field. E.E.B.

N66-10029 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VISUAL STUDY OF PLASMOIDS
K. D. Sinel'nikov, B. G. Safronov, V. G. Padalka, and I. I. Demidenko *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 307–313 refs (See N66-10001 01-25)

The study of the form of plasmoids and their behavior during motion in electrical and magnetic fields by means of the plasmoscope is discussed. The apparatus is described and the entrance of a plasmoid and its passage through a longitudinal uniform magnetic field and a field of toroidal configuration are determined. Results also qualitatively confirm the possibility of purification of hydrogen plasma from impurities of heavy ions during motion of the plasmoid in a magnetic field of a toroidal solenoid. E.E.B.

N66-10030 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INDUCTIVE CONICAL SOURCE OF PLASMOIDS
Yu. S. Azoskiy, I. T. Guzhovskiy, Yu. P. Mazalov, V. V. Mank, B. G. Safronov et al *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 317–335 refs (See N66-10001 01-25)

An inductive plasmoid source with conical single-turn coil was investigated. The source created plasmoids of hydrogen plasma with density higher than 2×10^{14} per cc. The average velocity of the plasma attained an average velocity of 3×10^5 meter/sec. The total number of particles accelerated to this velocity was on the order of 10^{19} particles or about 0.5 cc under standard conditions. Total energy of the plasmoid was on the order of 10^3 joules, which was about 25% of the energy entering the magnetic coil or about 8% of the total energy stored in the condensor bank. Total amount of impurities in the plasmoid was on the order of 10%. The plasmoid had comparatively large length of about 6 to 8 meters. E.E.B.

N66-10031 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONICAL SOURCE OF PLASMOIDS
Yu S. Azovskiy, I. T. Guzhovskiy, B. G. Safronov, and V. A. Churayev *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 336–343 refs (See N66-10001 01-25)

A conical source of plasmoids was studied with the aid of a vacuum chamber in the form of a glass pipe with internal diameter of 60 mm. Initial pressure in the vacuum system did not exceed 2.7×10^{-3} newtons/m^2. From the oscillograms of the signals and from the deceleration curves, it was observed that in the first and second half-periods of the discharge for the source with winding plasmoids are ejected with a high degree of ionization. The density of the charged particles in the first plasmoid was higher than 10^{12} per cc. Assuming that the amplitude of the magnetic probe signal is proportional to the particle density, the density in the second plasmoid is an order higher than in the first. In the third and subsequent half-periods of discharge, the ejected beam of weakly ionized gas had a density of charged particles higher than 10^{12} per cc. For the source without the winding, plasmoids of high density are formed in the first half-period but not in the second of the discharge. Currents in plasmoids are not induced since the magnetic field in the source has only an azimuthal component. Thus, the present investigation confirmed that the spiral conductor considerably increases efficiency of conical sources. E.E.B.

N66-10032 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF COAXIAL PLASMA ACCELERATOR
A. G. Belikov, V. P. Goncharenko, V. M. Mishchenko, B. G. Safronov, and A. S. Slavnyy *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 344–353 refs (See N66-10001 01-25)

A coaxial electrodynamic accelerator was investigated to clarify such parameters as velocity of plasmoids, their density, contamination of the plasma by heavy ions, and the energy distribution of the ions in the plasma. It was found that in the acceleration of a plasma by coaxial electrodynamic sources, two plasmoids are formed moving with different velocities. Formation of the plasmoids was not connected with periodicity of discharge in the source. The density of charged particles in the plasmoids was higher than 10^{13} per cc. The energy of the hydrogen ions was found to be from 4 to 5 keV in fast plasmoids. Considerable contamination was found in the plasmoids. Impurities were less in the fast plasmoids. E.E.B.

N66-10033 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF CAPTURE OF PLASMA IN MAGNETIC TRAP

V. G. Zykov, I. A. Stepanenko, V. T. Tolok, and K. D. Sinel'nikov *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 354–370 refs (See N66-10001 01-25)

Experiments are reported for the investigation of confinement of plasmas in a trap with counter fields during simultaneous counter plasma injection. It was found that there was a fourfold increase of amplitude of the diamagnetic signal during the meeting of the two plasma streams. Also, there was an increase of confinement time of the plasma in the central trap during injection through two end slots as compared with the time of confinement during injection through only one end slot. Tracks of the impacts of the plasma are shown during injection through three slots. The dependence of density of the ions and electron temperature on time are given for various conditions of plasma injection. E.E.B.

N66-10034 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INJECTION OF PLASMA THROUGH AN ANNULAR SLIT OF A TRAP WITH OPPOSED MAGNETIC FIELDS

V. G. Zykov, I. A. Stepanenko, V. T. Tolok, and K. D. Sinel'nikov *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 371–384 refs (See N66-10001 01-25)

Experiments are described which show that a plasma injected in the slit between opposed magnetic fields moves along the axis of the system. Strong interaction of opposed plasma fluxes was observed which existed without external magnetic fields. The nature of this interaction and the time of confinement of the plasma in the trap with such a method of injection require further investigation. E.E.B.

N66-10035 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF A SUPERSONIC STREAM OF CARBON DIOXIDE AS A TARGET FOR RECHARGING IONS

Ye. S. Boronvik, F. I. Busol, V. B. Yuferov, and Ye. I. Skibenko *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 385–402 refs (See N66-10001 01-25)

An investigation was conducted to determine the possibility of using a supersonic stream of carbon dioxide to recharge ions, and to ascertain if it were possible to maintain a sufficiently low pressure near the stream, and to observe the effectiveness of the recharge process. It was found that a supersonic stream of carbon dioxide was fully applicable as a target for recharge of ion beams with large apertures. Certain limitations on the application of a supersonic stream of CO_2 for recharge of ion beams of great intensity can be imposed by the dissociation of the CO_2 molecules since pumping out these dissociation products may require evacuation at a rate of thousands of liters/sec. Although cryogenic methods of evacuation can also be considered, the possibility that a supersonic stream of nitrogen, oxygen, or argon might be more expedient. Study of these streams require further investigation. E.E.B.

N66-10036 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF A SUPERSONIC STREAM OF NITROGEN AND ARGON

Ye S. Borovik, F. I. Busol, and V. B. Yuferov *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 403–412 refs (See N66-10001 01-25)

Supersonic streams of argon and nitrogen were studied as targets for recharge of ions in plasmas. Experiments with these gases were of interest because the theoretical angle of divergence of a supersonic stream for mono- and diatomic gases is less than for triatomic CO_2. The experiments showed that the creation of supersonic gas target streams with the use of condensers cooled by liquid hydrogen is possible. It was also observed that tubes cooled by liquid hydrogen or liquid helium were practically "ideally black" for molecules of all gases whose vapor pressure at the corresponding temperature is sufficiently low. Results were preliminary and further experiments are required to determine many details as yet unexplained. Data on nitrogen and argon are compared with those previously found for CO_2. E.E.B.

N66-10037 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ACCELERATION OF CHARGED PARTICLES BY LIGHT

Ya. B. Faynberg *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 415–441 refs (See N66-10001 01-25)

In connection with the development of methods of coherent amplification and the generation of electromagnetic waves in the visible spectrum, the possibility of acceleration of charged particles by light rays is of interest since the intensity of electromagnetic fields in focused light beams can attain values of 10^9 to 10^{10} V/meter. Such fields can be attained with comparatively small power requirements. The peculiarities and possibilities of the acceleration of charged particles by light waves is explored. The acceleration of heavy particles by a light wave moving at constant phase velocity for an energy less than 10^{14} eV is impossible. However, acceleration of electrons in the field of a light wave propagating with constant phase velocity for an energy less than 10^{14} eV is impossible. However, acceleration of electrons in the field of a light wave propagating with constant phase velocity is possible starting from an energy of about 100 MeV. The impossibility of acceleration of heavy particles in a light wave of constant phase velocity seriously complicates development of methods of acceleration. Methods of solving this difficulty are discussed. E.E.B.

N66-10038 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DIFFUSION IN NONUNIFORM RAREFIED PLASMA, CAUSED BY EXCITATION "ION-ACOUSTIC" OSCILLATIONS

V. D. Shapiro *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 442–458 refs (See N66-10001 01-25)

The magnitude of the coefficient of diffusion in a nonuniform plasma caused by the build-up of ion-acoustic oscillations is estimated allowing for the influence of oscillations on transfer processes in a plasma. Diffusion is considered both in the initial stage of oscillation development and also for the steady-state conditions. It is found that the contribution of ion-acoustic oscillations to diffusion are small. Consequently, other possible mechanisms of anomalous diffusion become important. It is observed further that instabilities of nonuniform plasmas and convection instability play an important role in processes of anomalous diffusion in the stellarator. E.E.B.

N66-10039 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON DIFFUSION OF STRIPPED PLASMA ACROSS A MAGNETIC FIELD
V. F. Aleksin and N. A. Khizhnyak *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 459–464 refs (See N66-10001 01-25)

The characteristics of the diffusion of charged particles in weakly ionized plasmas is reviewed and the diffusion of stripped plasmas across a magnetic field is examined in detail. Equations are presented to describe the motion of such plasmas and the significance of this phenomena is discussed. E.E.B.

N66-10040 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DECAY OF PLASMA IN A MAGNETIC FIELD
G. A. Silenok-Bel'skiy and Yu. Ya. Volkolupov *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 465–474 refs (See N66-10001 01-25)

The influence of a magnetic field on plasma diffusion in a transverse direction to the magnetic field was investigated. Experimental dependencies obtained for small degrees of anisotropy of the plasma properties indicated that diffusion across a magnetic field occurs as a result of paired collisions. In the case of a strong anisotropy the predominant mechanism apparently is recombination. The coefficient of recombination for hydrogen was found to be 2×10^6 cc/sec. Also, it was observed that the change in density of decaying plasmas depends on pressure and on the magnetic field. E.E.B.

N66-10042 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MICROWAVE METHODS OF DIAGNOSTICS OF PLASMOIDS
Yu. S. Azovskiy, I. T. Guzhovskiy, L. A. Dushin, V. I. Privezentsev, and V. A. Churayev *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 484–491 refs (See N66-10001 01-25)

Microwave methods are described for the investigation of the basic characteristics of a plasmoid. The plasmoid was propagated in a glass tube 60 mm in diameter and 1.2 meters long. Pressure of the residual gas in the vacuum system did not exceed 2.7×10^{-3} newton/m^2. The density distribution of the electrons and the forward velocity of the electron clusters were determined. E.E.B.

N66-10043 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDY OF BLACKENING OF PHOTOGRAPHIC PLATES UNDER THE INFLUENCE OF A POSITIVE ION BEAM
L. I. Krupnik and N. G. Shulika *In its* Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 492–497 refs (See N66-10001 01-25)

The dependence of the darkening of a nuclear photographic plate on the quantity of the incident hydrogen, helium, carbon, nitrogen, and oxygen ions per unit area with energies from 10 to 20 keV was determined. The ion beam was produced by an ion gun. The energy dependence of the process is discussed and equations are given for determining the parameters of intensity and charge per unit area of the photographic plate. E.E.B.

N66-10044 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MICROWAVE METHODS OF INVESTIGATION OF PLASMA IN AN EXTERNAL MAGNETIC FIELD
L. A. Dushin, V. I. Privezentsev, and A. I. Skibenko *In its* Phys. and Probl. of Controlled Thermonucl. Fusion, No. 3 9 Jul. 1965 p 498–507 refs (See N66-10001 01-25)

Microwave methods for the investigation of a plasma in an external magnetic field were examined for the case when polarization of the electric field of the wave is perpendicular to the external magnetic field. The experiments showed that the method can be useful in the case of a constant and a quasi-constant magnetic field. The application of transverse propagation is especially effective with values of the magnetic field approaching resonance. E.E.B.

N66-10106 Joint Publications Research Service, Washington, D. C.
ELECTRODYNAMIC PROPERTIES OF A NON-STATIONARY PLASMA
V. N. Lugovoy *In its* News of Higher Educational Inst. 28 Feb. 1964 p 87–98 refs (See N66-10101 01-23) CFSTI: $6.00

Conductivity tensor is calculated for nonrelativistic plasma affected by time-periodic strong external electromagnetic field, the varying component of the external magnetic field being parallel to the constant one. The full local absorption in the plasma is discussed in connection with possibility of the parametric amplification of electromagnetic waves. Author

N66-10107 Joint Publications Research Service, Washington, D. C.
COLLISION INTEGRAL FOR A PLASMA
V. P. Silin *In its* News of Higher Educational Inst. 28 Feb. 1964 p 99–111 refs (See N66-10101 01-23) CFSTI: $6.00

The collisions integral for particles in magnetized plasma is considered, both coulomb and transverse interaction of particles being taken into account. As a supplement the influence is investigated of the particles transverse interaction upon diffusion across a magnetic field in electron-positron plasma. The general expression is obtained for the diffusion coefficient connected with fluctuations of electromagnetic field in plasma. For the rarefied plasma the dependence is found of the diffusion coefficient upon the directivity of the fluctuational radiations. Author

N66-10108 Joint Publications Research Service, Washington, D. C.
ELECTROMAGNETIC WAVES IN AN INHOMOGENEOUS MEDIUM PIERCED BY A PLASMA BEAM
V. Ya. Eydman *In its* News of Higher Educational Inst. 1964 p 112–123 refs (See N66-10101 01-23) CFSTI: $6.00

Longitudinal electromagnetic oscillations are considered in nonuniform medium pierced by a plasma flow. It is shown that the nonuniformity of the medium may result in the radical change of stability criterion for the system. For instance, if the flow in uniform medium is unstable it may turn out to be stable provided the permittivity ϵ depends on coordinates. Author

N66-10109 Joint Publications Research Service, Washington, D. C.
LOW FREQUENCY OSCILLATIONS OF A COLD MAGNETOACTIVE PLASMA IN A GRAVITATIONAL FIELD
Ye. Ye. Lovetskiy and A. A. Rukhadze *In its* News of Higher Educational Inst. 28 Feb. 1964 p 124–135 refs (See N66-10101 01-23) CFSTI: $6.00

The spectrum of low-frequency oscillations of a weakly inhomogeneous cold plasma situated in a magnetic field and in a gravitational field is investigated in the quasi-hydrodynamic

approximation. The conditions under which the plasma oscillations are unstable are calculated, and the growth increments of the oscillations are obtained. Author

N66-10110 Joint Publications Research Service, Washington, D. C
RESONANT RADIATION OF A CHARGE MOVING NEAR A PLASMOID
G. V. Gorodinskiy and V. V. Tamoykin *In its* News of Higher Educational Inst. 28 Feb. 1964 p 136–150 refs (See N66-10101 01-23) CFSTI: $6.00

The radiation of a uniformly moving charge near a plasma sphere is considered in the approximation $ka << 1$. It is shown that at frequencies corresponding to dipole, quadrupole, and higher multipole resonances, a resonant radiation appears, the intensity of which greatly exceeds the energy radiated by the charage moving over a metallic sphere of the same dimensions. Author

N66-10122 Joint Publications Research Service, Washington, D. C.
RADIATION FRICTION DECELERATION OF A CHARGE MOVING IN A PLASMA SITUATED IN A MAGNETIC FIELD
Ye. G. Lariontsev and V. D. Shafranov *In its* News of Higher Educational Inst. 28 Feb. 1964 p 372–377 refs (See N66-10101 01-23) CFSTI: $6.00

A general expression for the work done by the radiation friction force on the translational and rotational degrees of freedom of a charge is derived which permits direct quantum mechanical interpretation. It is shown that there is not only a qualitative agreement between the quantum mechanical derivation and the classical calculations but also a complete quantitative correspondence. E.E.B.

N66-10123 Joint Publications Research Service, Washington, D. C.
CONCERNING THE DAMPING OF ELECTROMAGNETIC WAVES IN A PLASMA PLACED IN AN INHOMOGENEOUS DIELECTRIC
V. Ya. Eydman *In its* News of Higher Educational Inst. 28 Feb. 1964 p 378–380 ref (See N66-10101 01-23) CFSTI: $6.00

The propagation of a plasma wave in a layered-inhomogeneous medium with slowly varying properties is considered. It is assumed that a homogeneous plasma is placed in an inhomogeneous dielectric. The perturbation method in the geometrical-optics approximation is used to determine the absorption coefficient of the plasma wave. The radiating ability is then determined in order to indicate the connection between the damping of the plasma wave and the transition radiation. Equations are derived to show that the plasma-wave damping is due to transition radiation. E.E.B.

N66-10168# Princeton Univ., N. J. Plasma Physics Lab.
MAXIMAL ORDERING STABILITY PROBLEM
E. Frieman, K. Weimer, and P. Rutherford Sep. 1965 26 p refs
(Contract AT(30-1)-1238)
(MATT-370)

Efforts were made to find the relations between a number of hydromagnetic, resistive, and microscopic instabilities for plasma containment devices which depend on shear stabilization. The objectives were to determine whether a stable operating regime exists and whether other modes of instability remain to be discovered. The results give a general picture of the various types of instability which can occur in the stellarator geometry, and indicate that there are basically two modes which occur in all circumstances. These are the shear Alfven mode and the drift mode. It is shown that the Alfven mode tends not to become as highly localized as the drift mode and is more easily destabilized by the various effects which create a parallel electric field, namely, electron inertia, parallel pressure gradients, and resistivity. On the other hand, it is noted that the drift mode can be localized and stabilized by shear, but as β increases, the amount of shear required also increases. It is concluded that it is possible to stabilize all modes in this model of the stellarator with sufficient shear and high enough temperature. R.R.D.

N66-10202# Princeton Univ., N. J. Plasma Physics Lab.
MEASUREMENTS OF POWER BALANCE AND PARTICLE LOSS RATE IN OHMICALLY-HEATED DISCHARGES IN THE C STELLARATOR
A. S. Bishop and E. Hinnov Sep. 1965 19 p refs
(Contract AT(30-1)-1238)
(MATT-371)

From measurements of the absolute intensity of radiation emitted from helium and hydrogen discharges in the C stellarator, power balance analyses have been carried out over a rather wide range of discharge conditions. Results show that the power input can be satisfactorily accounted for in terms of radiation, ionization, and heating of the working gas, with losses due to other processes playing no major role. By substracting the ionization rate (as determined from such radiation data) from the observed rate of change of plasma density, the particle loss rate can also be determined. In parallel with the above work, we have developed and programed (for the IBM 7094 computer) a set of equations which simulates the time behavior of discharges in the stellarator. Rather satisfactory agreement is obtained between computer and experimental results throughout the discharge pulse. Author

N66-10216# Aerojet-General Nucleonics, San Ramon, Calif.
RESEARCH ON VOLTAGE GRADIENTS FROM ELECTRON-ACOUSTICAL WAVES Final Technical Report
C. B. Kretschmer Mar. 1965 33 p refs
(Contract AF 49(638)-1347)
(AN-1398; AFOSR-65-1044; AD-620223)

Experimental work was conducted on an energetic argonfed hollow cathode arc. The arc column had a diameter of 1.27 cm and a length of 60 cm. Microwave interferometer measurements at 1.20×10 to the 11th power cps gave a plasma density of 1.8×10 to the 14th power electrons/cu cm, and spectroscopic line intensity measurements yielded an electron temperature of 1.1 ev. The voltage gradient along the arc was less than 0.1 v/cm. Since a voltage gradient of 10 to 20 v/cm would be required to produce current densities of the observed magnitude in a plasma with an electron temperature of 1.1 ev by ordinary conduction, it is believed that the arc current is carried by electrons which are trapped in electron plasma waves and accelerated to high velocity by the waves. Attempts to detect radiation emitted by the plasma at the electron plasma frequency gave inconclusive results. Strong signals were detected at frequencies below 500 kc. The arc column was found to radiate as much as 73% of the input power in the vacuum ultraviolet region between 400 A and 1000 A, with a large fraction concentrated between 430 A and 540 A. Many lines of singly through quadruply ionized argon were identified. Doubly ionized argon appeared to be the most abundant species. Author (TAB)

N66-10371# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TEMPERATURE BOUNDARY LAYER OF A FLAT PLATE IN ANISOTROPIC MAGNETOHYDRODYNAMICS

V. B. Baranov 6 Aug. 1965 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, OTD. Tekhn. Nauki Mekhan. i Mashinostr. (Moscow), no. 6, 1962 p 3–5
(FTD-TT-65-924/1; AD-619434)

In an ionized gas in which the condition of smallness of the Larmor rotation frequency of charged particles as compared with the frequency of their collisions is disturbed, the transfer coefficients are different in the direction of the magnetic field and perpendicular to the field. Assuming gas in compressibility, equations are derived for calculating the boundary layer of a flat plate in the presence of a magnetic field parallel to the plate, and the velocity of the incident flow. Author (TAB)

N66-10380# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LONGITUDINAL STABILITY OF ONE-DIMENSIONAL FLOW OF A CONDUCTING GAS
Ye. V. Artyushkov and A. I. Morozov 9 Aug. 1965 21 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur (USSR), v. 2, no. 4, 1964 p 525–534
(FTD-TT-65-953/1+2; AD-620804)

The stability of short-wave longitudinal oscillations in one-dimensional flow of a gas with finite conductivity in a magnetic field is investigated. Defrosted oscillations are considered taking into account large and small thermal conductivity. Expressions are obtained which determine the variation in wave amplitude along the flow. Author (TAB)

N66-10466# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Inst. of Chemistry.
THE PLASMA BURNER AND ITS APPLICATION TO ROUND MELTS OF VARIOUS MATERIALS [DER PLASMABRENNER UND SEINE VERWENDUNG ZUM RUNDSCHMELZEN VERSCHIEDENER MATERIALIEN]
A. Strigl and H. Bildstein [1964] 14 p refs In GERMAN (SGAE-CH-12) CFSTI: HC $1.00/MF $0.50

A plasma melting installation was described that is suitable for the preparation of round fused particles from metals, oxides, and carbides. The various factors affecting the fusibility were discussed, and results on melt studies were reported. Author (NSA)

N66-10530# Polytechnic Inst. of Brooklyn, N. Y. Electrophysics Dept.
NONLINEAR MAGNETOPLASMADYNAMICS
Melvin Sandler Mar. 1965 95 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1242-64; AD-473611)

A number of devices involving magnetoplasma interactions are studied with the aid of a one-dimensional model. Analytic solutions to limiting cases provide insight and aid in the formulation of a general numerical technique. A study is made of the stability of the resulting finite difference scheme and a viewpoint is presented for choosing computation schemes in complex problems. Author

N66-10537# Nagoya Univ., Japan. Inst. of Plasma Physics.
ON THE KINETIC STRUCTURE OF A PLASMA
John M. Dawson and Toshio Nakayama Jul. 1965 41 p refs
(IPPJ-39) CFSTI: HC $2.00/MF $0.50

In this paper the kinetics of a plasma is investigated by expanding the motion in terms of the deflection of the particles from their noninteracting orbits. It is shown that this procedure leads to the following results. At the first stage, the dressed particle picture of Thompson and Hubbard, and of Rostoker for obtaining fluctuations in a plasma is obtained. Rostoker's principle for obtaining two particle correlations in terms of test particle results is also obtained at this stage. At the second stage, encounters between shielded particles appear and the picture of Birmingham, Dawson and Oberman for computing bremsstrulung emerges. The usual Fokker–Planck equation may also be obtained at this stage. The treatment applies to the full electromagnetic field. Author

N66-10545# Technische Hochschule Stuttgart (West Germany).
THE HANDLING OF MAGNETOHYDRODYNAMIC CIRCULATION PROCEDURES IN THERMODYNAMIC EQUILIBRIUM DIAGRAMS [DIE BEHANDLUNG MAGNETOFLUIDODYNAMISCHER STROMUNGSVORGANGE IN THERMODYNAMISCHEN ZUSTANDSDIAGRAMMEN]
Karl Heinz Lillich 1964 107 p refs In GERMAN CFSTI: HC $4.00/MF $0.75

Composition and thermodynamic phase values for the thermodynamic equilibrium states of various gases, as presented in enthalpy-entropy diagrams, were extended to include the magnetohydrodynamic flow conditions. Phase change values of the gas medium during magnetohydrodynamic flow were obtained with thermodynamic phase diagrams for the real state of the gas under consideration of the developed dissociation and ionization changes. Sample calculations for the enthalpy-entropy, and enthalpy-density diagrams of a magnetohydrodynamic energy process are given. G.G.

N66-10709# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
STABILITY OF SHEET PINCH
Fang C. Hoh Aug. 1965 34 p refs
(DI-82-0455)

The growth rate of the sheet pinch instability is calculated in the small Larmor radius limit using the method of integration along unperturbed orbits. It is found that the instability is driven by a small group of "resonant" ions which cross and drift about the neutral plane having zero velocity along the field lines. The micro-instability is absolute and develops fastest for a critical perturbation wavelength, of the order of several times the thickness of the plasma sheet. Author

N66-10730# Boeing Scientific Research Labs., Seattle, Wash.
ACCELERATION PROCESSES AND THE TAIL OF THE MAGNETOSPHERE
F. C. Hoh Jul. 1965 32 p refs
(DI-82-0457)

The sheet pinch model is applied to, and gives detailed properties of the neutral sheet in the tail of the magnetosphere. Acceleration processes associated with the neutral sheet are suggested and discussed. Author

N66-10825# Stanford Univ., Calif. Microwave Lab.
PLASMA RESONANCE PROBE CHARACTERISTICS IN A MAGNETIC FIELD Interim Technical Report
F. W. Crawford Jun. 1965 22 p refs
(Contract AF 33(616)-8121)
(ARL-65-115; AD-620910)

The operation of the plasma resonance probe in the absence of a magnetic field is now well understood, and the resonant frequency can be interpreted to give the electron density in the plasma. In many potential applications of this diagnostic technique to laboratory and space plasmas, a static magnetic field is present. This paper considers the resulting modifications to the resonance. The analysis is based on the simplified model

of the probe behavior that has been validated for the zero magnetic field case by the work of Harp and Crawford. It is concluded that the technique can be applied to obtain the electron plasma frequency, ω_p, and the electron density for $\omega_c^2 << \omega_p^2$, and the electron cyclotron frequency, ω_c, and hence the local magnetic field when $\omega_c^2 >> \omega_p^2$. An approximate correction formula is derived for the intermediate range, $\omega_c^2 \approx \omega_p^2$. Author

N66-10962# National Research Council of Canada, Ottawa (Ontario).
ESTIMATION OF HEATING OF A PLASMA BY LASERS [ABSCHATZUNGEN ZUR AUFHEIZUNG EINES PLASMAS MITTELS LASERN]
H. Hora 1965 23 p refs Transl. into ENGLISH from Inst. für Plasmaphysik Rept. IPP/6/23, 1964
(NRC-TT-1193) CFSTI: HC $1.00/MF $0.50

A heating model with long ionization time was considered, and cases with short ionization were discussed. Under the general assumption of completed thermalizatiion, fusion-liberated energies of less than 1/1000th of the laser energy were obtained for normal laser energies. It was also found that the losses due to bremsstrahlung, recombination, radiation, and cylcotron radiation in the presence of magnetic fields were negligible, due to the brief times involved. Earlier estimations of whether plasmas were heated with brief laser impulses to temperatures of interest with respect to thermonuclear conditions were continued, stating that the high light field intensities would produce a nonresonant ionization. Some rough estimates were made indicating that more favorable heating was achieved with the greater densities that were attainable. R.W.H.

N66-10965# Princeton Univ., N. J. Plasma Physics Lab.
FINITE LARMOR RADIUS HYDROMAGNETICS
Charles F. Kennel and John M. Greene Sep. 1965 59 p refs
(Contract AT(30-1)-1238)
(MATT-363)

A complete set of fluid equations in the so-called finite Larmor radius or drift approximation is obtained by a systematic asymptotic expansion using the gyration period and radius, respectively, as small space and time parameters. The time and space scales must be linked together by velocities characterizing the plasma. In this case, these velocities are chosen to be the so-called gradient and pressure drifts, whereas in ordinary hydromagnetics the Alfvén and thermal velocities are used. This limit is particularly relevant for high temperature spatially inhomogeneous plasmas. Given this linkage, rough physical arguments are used to obtain scalings for all the other variables in the theory. Careful attention is then paid to consistency and inclusiveness in the derivation of the equations. This set is applied to the simple problem of linear wave propagation and stability in a one-dimensional inhomogeneous plasma. It provides a unified treatment of FLR wave phenomena. Author

N66-10971# Princeton Univ., N. J. Plasma Physics Lab.
CONVERGENCE OF ITERATION BASED ON PRIGOGINE'S GENERALIZED VARIATIONAL PRINCIPLE
M. Kruskal Aug. 1965 8 p Presented at Symp. on Non-Equilibrium Thermodyn., Variational Tech. and Stability, Chicago Univ., 17–19 May 1965
(Contract AT(30-1)-1238)
(MATT-368)

Presented is the local potential or generalized entropy production integral associated with the steady-state heat equation. It was suggested that an iteration procedure, converging to a solution, with fixed boundary conditions: (1) take a trial function T_0; (2) find T which minimizes $\phi(T,T_0)$ among functions satisfying the boundary conditions; and (3) use T as the function T_0 for the next step of the iteration. The convergence of the iteration in terms of the ratio of end temperatures may be expressed in the following manner:

$$\frac{b}{a} = \frac{t(L)}{t(0)}$$

It was pointed out that the heat equation was invariant under a redefinition of T by an additive constant (with a corresponding redefinition of λ if necessary), while ϕ was not correspondingly invariant. Therefore, the convergence behavior of the iteration procedure was changed at will be redefinition. It was suggested that instead of the single local potential, the one-parameter family of local potentials could have been introduced. R.W.H.

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N66-10111 Joint Publications Research Service, Washington, D. C.
QUADRUPOLE ENERGY LEVELS FOR SOME SPINS
V. S. Grechishkin and N. Ye. Aynbinder *In its* News of Higher Educational Inst. 28 Feb. 1964 p 151–164 refs (See N66-10101 01-23) CFSTI: $6.00

Expressions are obtained for the quadrupole energy levels of nuclei with integer spins J = 2, 3, and 4 in the case of arbitrary value of the asymmetry parameter of the gradient of the electric crystal field η. For the spin J = 5/2 the parameters of the zero splitting of the Zeeman spectrum of nuclear quadrupole resonance are tabulated (in the interval of η from zero to 1). Experiments by the zero-splitting cone method have been carried out on single crystals of $SbCl_3$ and $2SbCl_3 \cdot C_6H_6$ (resonance Sb^{121}, J = 5/2). The tables are used to obtain values of the asymmetry parameter η for these single crystals, found to equal 0.15 and 0.10 respectively. Author

N66-10153 Naval Research Lab., Washington, D. C. Radiation Div.
SCATTERING OF POLARIZED NEUTRONS BY SPIN WAVES IN MAGNETITE
G. A. Ferguson, Jr., A. W. Sáenz, and A. D. Anderson *In its* Rept. of NRL Progr. Feb. 1965 p 10–19 refs (See N66-10151 01-34)

The scattering of polarized 1.08 A neutrons by acoustic spin waves in magnetite at 300° K was measured. In most of the measurements the magnetite scatterer was oriented near the position for (111) Bragg reflection. For large enough angles of crystal misset (±10°) from this position, satisfactory quantitative confirmation was obtained for the theoretical predictions of the dependence of this scattering on the incident neutron polarization. For smaller angles of misset from the (111) position, it is not possible to decide unambiguously on the basis of the present measurements whether or not these theoretical predictions hold for magnetite. A possible way of reconciling theory and experiment is to suppose that both phonons and magnons contribute significantly to the scattering at such small angles. The scattering of polarized neutrons of the given

wavelength by magnetite was also measured in the neighborhood of the (220) Bragg setting and was found to agree qualitatively with theory, but no quanitative comparison was attempted. Author

N66-10156 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATIC CALCULATION OF DISLOCATIONS
A. L. Sobolev and Yu. V. Sokurenko *In its* Instr. and Exptl. Tech. 30 Jun. 1965 p 6-13 refs (See N66-10154 01-23)

Discussed are methods of calculating dislocations in germanium and silicon samples and a description is given of the block-diagram of a TV automatic counter, manufactured on the basis of industrial TV installation PTU-OMI. Author

N66-10220# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF GAMMA-RADIATION ON CERTAIN OPTICAL PROPERTIES OF SYNTHETIC RUBY
S. V. Starodubtsev and M. S. Yunusov 25 Jun. 1965 6 p ref Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), no. 1, 1964 p 92-94
(FTD-TT-65-20/1+2+4; AD-620096)

Crystals of bright pink ruby were examined (content Cr_2O_3 0.2%) to investigate the appearance of color centers, their dependence upon dosage of radiation, stability of these centers, as well as the process of their decolorization. We bombarded with gamma rays Co60 with a dosage capacity of 350 r/sec at a temperature in the source of 34C. TAB

N66-10265# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
RELATIVISTIC EFFECTS IN CRYSTALS
T. C. Loucks 14 Jun. 1965 9 p refs Presented at Midwest Theoret. Conf., Ohio State Univ., Columbus, 1965
(Contract W-7405-ENG-42)
(IS-1172; CONF-650542-1)

The relativistic effects on the Fermi surfaces of metals are studied. An investigation for finding Block functions which satisfy the Dirac hamiltonian $H = \vec{\alpha} \cdot \vec{p} + \beta + V$ where V is the crystal potential and has the periodicity of the lattice is presented. (NSA)

N66-10266# Los Alamos Scientific Lab., N. Mex.
RESULTS OF AUGMENTED PLANE WAVE CALCULATIONS OF THE BAND STRUCTURE OF CERIUM METAL
J. T. Waber (Los Alamos Sci. Lab.) and A. C. Switendick (Sandia Corp.) [1965] 10 p refs
(Contract AT(29-1)-789)
(SC-DC-65-1500; CONF-650804-5)

Ten sets of electronic band structure calculations were performed for cerium metal by using the augmented plane wave method for five configurations of the type $6s^2 5d^x 4f^{2-x}$ and the lattice constants appropriate to the FCC gamma and FCC alpha phases. It is shown that the location of the f band is strongly dependent on the atomic configuration assumed in starting the calculation. The relation of these results to previous atomic calculations is discussed. It is believed that the bands should not be occupied to a common energy level according to a simple Fermi-Dirac distribution, but rather that the 4 electrons outside the xenon core should be arranged in the f as well as in the s and d bands so as to be reasonably consistent with the configuration assumed. As a consequence the f-band location is dependent on the degree to which it is occupied. The two-electron calculations by Waber, Liberman and Cromer of the total energy for a cerium atom confined to a Wigner-Seitz sphere lend further support to this assignment hypothesis. Author

N66-10267# Sandia Corp., Albuquerque, N. Mex.
STRUCTURE AND ELECTRICAL PROPERTIES OF VACUUM-DEPOSITED CdS THIN FILMS
L. E. Terry and E. E. Komarek Nov. 1964 22 p refs
(Contract AT(29-1)-789)
(SC-TM-64-1677)

The effects of condensation rate, substrate temperatures and post-deposition treatment on the electrical and structural properties of CdS have been investigated. Rates of from 1 Å/sec and substrate temperatures from 40 to 275° C were studied. X-ray diffraction and reflection electron diffraction indicates that the films are highly orientated in the hexagonal phase with the "C" axis perpendicular to the substrate. Post-deposition treatments of vacuum and/or air bake at 400° C for 1 hour have no apparent effect on the orientation. At rates of 1-7 Å/sec the film resistivity increases from 1Ω-cm to 10^5Ω-cm with an increase in substrate temperature from 40 to 275° C. Hall mobility increases in an orderly fashion from 1 to 15 cm^2/v-sec over this same substrate temperature range. Films formed on 200° C substrates at increasing rates have resistivity decreasing to 10Ω-cm at a rate of 200 Å/sec. Author

N66-10271# Oak Ridge National Lab., Tenn.
INTERMEDIATE STATES AS OBSERVED BY DIFFERENTIAL SCATTERING OF NEUTRONS BY DOUBLY CLOSED SHELL NUCLEI, SESSION IV
C. H. Johnson and J. L. Fowler [1965] 5 p refs Presented at the Intern. Conf. on the Study of Nucl. Struct. with Neutrons, Antwerp, 19-23 Jul. 1965
(Contract W-7405-ENG-26)
(ORNL-P-1356; CONF-650706-3)

The differential cross section and phase shift analyses for neutrons scattered from ^{16}O and ^{208}Pb are included. Results were corrected for the effects of spurious neutron backgrounds, self-attenuation and multiple scattering in the sample, finite angular resolution, and the energy dependence of the detector efficiency. (NSA)

N66-10363# Los Alamos Scientific Lab., N. Mex.
A SIMPLE EXPRESSION FOR THE QUARTIC ANHARMONIC CONTRIBUTION TO THE HELMHOLTZ FREE ENERGY OF A SPECIAL MODEL OF AN F.C.C. CRYSTAL
A. A. Maradudin 27 Sep. 1965 10 p refs
(Contract W-7405-ENG-36)
(LA-3379-MS) CFSTI: $1.00

In general, the calculation of the quartic anharmonic contribution $F_4(T)$ to the free energy of a crystal involves double summation over the Brillouin zone. Thus, its usefulness is often limited because of the enormous amount of numerical work required for its evaluation. However, for many crystals one obtains a satisfactory approximation by considering only nearest neighbor interactions. For this case it is here shown that $F_4(T)$ simplifies to an expression involving the square of a single summation over the zone. The proof is for a face-centered cubic crystal. The expression is valid at all temperatures and can be written as an integral over the frequency spectrum; furthermore, it is unnecessary to calculate the eigenvectors. This new result enables a simple and ready calculation of the thermodynamic properties corresponding to $F_4(T)$. Author

N66-10448*# Radio Corp. of America, Harrison, N. J. Electronic Components and Devices.
HIGH MAGNETIC FIELD SUPERCONDUCTING PROPERTIES OF Nb_3Sn FILMS Final Report
N. S. Freedman, H. C. Schindler, F. R. Nyman, and K. Strater Aug. 1965 72 p refs
(Contract NAS3-4113)
(NASA-CR-54183) CFSTI: HC $3.00/MF $0.75 CSCL 20L

The shielding characteristics of niobium-stannide layers varying in thickness and critical current, deposited on the exterior of steatite, Hastelloy, and nickel cylinders were investigated. Maximum magnetic fields shielded in this fashion free from flux jumps were two kilogauss. Stacked discs of concentric rings of niobium-stannide shielded 12 kilogauss free from flux jumps in a 0.500-inch inside diameter. This principle of concentric niobium-stannide rings is equally well adaptable to other superconductive devices where flux jumps have been a major problem. Electron bombardment of niobium-stannide with an integrated flux density of 10^{18} electron/cm^2 produced a 50 percent reduction in critical current. No deleterious effects on the niobium-stannide were observed below the cumulative 10^{18} electron/cm^2 density level. Author

N66-10503# California Univ., Berkeley. Lawrence Radiation Lab.
PLASTIC DEFORMATION OF MGO SINGLE CRYSTALS UP TO 1600°C
Stephen M. Copley and Joseph A. Pask 7 Apr. 1964 23 p refs
(Contract W-7405-ENG-48)
(UCRL-10316)

Stress-strain curves are presented for Mgo single crystals, compressed with <100> and <111> stress axes, for temperatures of 1000 to 1600° C. The yields stress of <100> specimens decreases slightly in this temperature range. The strain-hardening rate passes through a maximum at about 1100° C and decreases by a factor of about 8 at 1600° C. Above this temperature, the strain rate of <100> specimens is much less sensitive to changes in stress and the shape of the stress-strain curves changes. The yield stress of <111> specimens decreases rapidly with increasing temperature without a change of slope up to 1600° C. The ratio of the yield stresses for <111> and <100> specimens decreases continually from 1200 to 1600° C. Author

N66-10508# Temple Univ., Philadelphia, Pa.
CRYSTAL FIELD EFFECTS IN ZIRCONIUM OXIDE
John Patrick Meehan (Ph.D. Thesis) May 1965 49 p refs
(Contract AT(30-1)-2082)
(TID-21946)

Zirconium oxide was doped with chromium and vanadium at concentration levels of ~ 1%. Optical and paramagnetic resonance spectra of the doped systems were obtained, and were interpreted by means of the ligand field theory. The optical spectrum of the ZrO_2:V systems indicated that a charge transfer process was responsible for the intense absorption above 19000 cm^{-1}. This strong absorption suggested the presence of vanadium (V) in the ZrO_2 lattice. The magnetic resonance spectrum of ZrO_2:V reveals the presence of vanadium (IV) in the lattice. This oxidation state was represented as VO^{+2}, the vanadyl ion. Information on the nature of the chemical bonding in the zirconium oxide was obtained by considering the optical spectrum of the ZrO_2:Cr system. The reduction of the $^4F-{}^4P$ term separation, and the reduction of the Racah B parameter for the chromium (III) ion in ZrO_2 indicated that the interelectron repulsion energy for the chromium (III) ion in the ZrO_2 lattice was reduced. R.W.H.

N66-10533# Union Carbide Corp., Parma, Ohio. Parma Research Lab.
MEASUREMENTS OF THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF AN HIGHLY ANISOTROPIC ZT-TYPE GRAPHITE AT HIGH TEMPERATURES
J. N. Pike 22 Apr. 1963 31 p refs
(Contract DA-30-069-ORD-2787)
(C-16; AD-404453)

Measurements of with-grain and against-grain thermal conductivities and electrical resistivities have been made (over the temperature range 1200–2800° K) of samples of a bulk density 2.15, controlled orientation, ZT-type graphite. The anisotropy in electrical resistivity $\rho_\perp/\rho_\parallel$ drops smoothly from its room temperature values of 7.0 to a value of 4.5 at 2400° K and appears to level off at higher temperatures. At high temperatures, the anisotropy in thermal conductivity $K_\parallel/K_\perp$ is 20–30 percent lower than $\rho_\perp/\rho_\parallel$. At 2400° K, typical thermal conductivities are $K_\parallel = 0.6$ watt cm^{-1} deg^{-1}, $K_\perp = 0.15$ watt cm^{-1} deg^{-1} deg^{-1}. Total emissivities are also measured on the assumption that spectral emissivity at the pyrometer wavelength is 1.0, and, when conduction losses along some of the samples are properly accounted for, are found to be in reasonable agreement with the literature. Author

N66-10549# Atomics International, Canoga Park, Calif.
THE INFLUENCE OF α IRRADIATION AT LOW TEMPERATURE ON THE INTERNAL FRICTION OF SUPERPURITY COPPER
D. Könic, J. Völkl, and W. Schilling Feb. 1965 12 p refs Transl. into ENGLISH from Phys. Status Solidi, v. 7, 1964 p 577–590
(AI-TRANS-75)

Copper foils (99.999% purity) 5μm thick and about 6 mm long and 2 mm wide firmly fastened at one end were irradiated at about 30° K with α particles from a ^{210}Po source, and then excited to transverse oscillations. The internal friction was determined from the decrease of the amplitude. It was found that α irradiation at first almost completely suppresses the Bordoni peak. It reappears only slowly again annealing at temperatures above 125° K, but does not reach its original height again even after heating to about 400° K. Rather, it becomes smaller after each irradiation and recovery cycle. The familiar secondary peak fails to reappear after the first irradiation. A series of peaks (at about 39° K, 104° K, 170° K, and 240° K) are produced by the irradiation and may probably be explained by the interaction of dislocations with point defects.
Author (NSA)

N66-10647*# Space Technology Labs., Inc., Redondo Beach, Calif.
[CARRIER LIFETIME MEASUREMENTS AND RECOMBINATION CHARACTERISTICS IN SILICON AND STUDIES PHENOMENA ASSOCIATED WITH RADIATION INDUCED DEFECT LEVELS]
R. G. Downing 20 Aug. 1965 2 p
(Contract NAS5-3805)
(NASA-CR-67631) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Minority carrier lifetime measurements in silicon were decided to be of vital importance in determining recombination characteristics in silicon. It was also agreed that considerable effort should be expended on the annealing characteristics of radiation-induced defect levels, and the effect of different dopant materials on radiation-induced defect levels. Annealing studies were made on the $E_v + 0.3$ ev and on the $E_c - 0.17$ ev levels. The repeated efforts showed that the $E_v + 0.3$ ev does not anneal to any extent at 400° C or lower. Material used in these studies had a high resistivity, low dislocation, and was crucible grown. R.W.H.

N66-10725# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
THE DETERMINATION OF THE SPECIFIC CONDUCTANCE OF REFRACTORY MATERIALS IN VACUUM UP TO 2200° C
A. N. Lulichev, F. I. Chuprinin, and S. I. Kovalenko Apr. 1965 5 p ref Transl. into ENGLISH from Zavodsk. Lab. (Moscow), v. 23, no. 8, 1957 p 931
(AAEC/TRANS-18) CFSTI: HC $1.00/MF $0.50

A method is described to determine electrical conductance of refractory materials in a vaccum at temperatures up to 2200° C. Determinations were made in a rig evacuated to approximately 5×10^{-5} mm mercury, with ultimate vacuum being 2×10^{-5} mm. Various oxides were heated by two graphite plates; the heating element was protected with a shield of tantalum plates; specimens were clamped between two molybdenum electrodes which pass through apertures in the shield. Satisfactory reproducible results were shown in a series of electrical conductance determinations on Al_2O_3, MgO, and ZrO_2. Conductance measurements on ZrO_2 were terminated at a temperature of 1800° C because of the low resistance of the specimens; at temperatures above 1900° C, MgO specimens disintegrated. M.W.R.

N66-10763# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE RELATIONSHIP BETWEEN PARAMAGNETIC AND ELECTRIC PROPERTIES OF CERTAIN ORGANIC SEMICONDUCTORS
A. D. Grishina and A. V. Vannikov 29 Jun. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 156, no. 3, 1964 p 647–649
(FTD-TT-65-306/1+4; AD-620076)

The relationship between paramagnetic and electric properties of radiation-thermal modification of polyethylene is discussed. On the basis of previous studies it was concluded that the paramagnetism of this polymer is not determined by specific characteristics of strongly conjugated systems but is due to the presence of delocalized unpaired electrons. Further investigation of this phenomena has indicated that in polyethylene paramagnetism is due to structural defects of broken bonds at temperatures less than 800° C. At temperatures above 850° C paramagnetism apparently is bound with the charged carriers. E.E.B.

N66-10775*# Stanford Univ., Calif. Solid-State Electronics Labs.
FUNDAMENTAL STUDIES OF THE METALLURGICAL, ELECTRICAL, AND OPTICAL PROPERTIES OF GALLIUM PHOSPHIDE Quarterly Progress Report, Jul. 1–Sep. 30, 1965
[1965] 43 p refs
(Grant NsG-555)
(NASA-CR-67780) CFSTI: HC $2.00/MF $0.50 CSCL 20B

Fundamental investigations are presented on the metallurgical, electrical, and optical properties of gallium phosphide. Included are a study of the $GaAs_xP_{1-x}$ alloy system; the chemical, electrical, and optical properties of cobalt as an impurity in gallium phosphide; the properties of rectifying junctions in GaP and $GaAs_xP_{1-x}$, and the properties of GaP and $GaAs_xP_{1-x}$ relevant to their use as semiconducting materials. R.N.A.

N66-10841# Ecôle Normale Supérieure, Paris (France). Laboratoire de Physique.
INFRARED STUDY OF LOCALIZED VIBRATIONS IN SILICON DUE TO BORON AND LITHIUM Scientific Report No. 3
M. Balkanski and W. Nazarewicz [1965] 33 p refs
(Contract AF 61(052)-789)
(AFCRL-65-590; AD-621076)

Infrared absorption was used to determine the characteristics of localized modes in silicon due to the electrically active impurities, the isotopes of boron and lithium. The impurity and isotopic origin of all peaks was indicated. An attempt was made to deduce the configuration of both impurities in the lattice from the number of observed peaks. The temperature effect on the position, width, and integrated intensity of absorption peaks was measured. The temperature dependence of the position and line width may indicate the role of anharmonic forces around the impurities. The study of the temperature dependence on the integrated absorption is a means of distinguishing the one-phonon absorption caused by other processes. TAB

N66-10846# New York Univ., N. Y. Dept. of Physics.
STUDY OF THE MECHANISM AND PROPERTIES OF THE PHOTOVOLTAIC AND PHOTOCONDUCTIVE EFFECTS IN ORGANIC SUBSTANCES Final Report, 1 Nov. 1963–31 Oct. 1964
Harmut P. Kallmann [1964] 20 p refs
(Contract AF 19(628)-2446)
(AFCRL-65-240; AD-621138)

Research results in the following areas are reported: Larger than band gap photovoltages in anthracene, germanium layers, and evaporated zinc sulfide layers; and photovoltages due to inhomogeneous absorption of light and to chemical effects in organic solutions (E.G., alpha-methyl naphthalene, benzene, hemimellitine, mesitylene) and in cadmium sulfide single crystals. TAB

N66-10960# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
PLASMA PHYSICS LABORATORY REVIEW, JANUARY–JUNE 1965
[1965] 29 p refs

Radio frequency modulation on light from the sun, stars, and a nebula was found and observed as a new technique. Other developments relative to communications were a practical approach to the reentry radio blackout problem and studies of a new solid state source of microwaves. Research on the control of power from hydrogen bomb reactions was aided by studies of very small, cold bits of semiconductors. Concurrently, a billion watt laser to emulate some properties of the hydrogen bomb explosion is in use. This work is conducted along with related studies of a plasma accelerator. This device holds promise of providing in a shielded laboratory a small model of an H-bomb explosion in space. Such an experimental device would be very useful in space weapons studies in addition to its contribution to research on superhot plasmas. R.W.H.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N66-10213# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
SOLID PROPELLANT COMBUSTION MECHANISM STUDIES Fifteenth and Sixteenth Progress Report, 1 Oct. 1963–31 Mar. 1964

Richard B. Cole and Joseph Wenograd 17 Jun. 1965 139 p refs
(Contract Nonr-1858(32); ARPA Order 23)
(Rept.-446-o; AD-467728)

Two composite solid propellant combustion experiments are reported; one deals with burning surface photomacroscopy, and the other with the influence of oxidizer particle size on low pressure combustion. The first investigation involved photography of the surfaces of 1/4 inch square polysulfide-ammonium perchlorate (unmetallized) propellant strands during combustion in a coaxially-flowing nitrogen environment. The experiment and the apparatus used are described in detail. Among the findings were that useful combustion pressures for high resolution surface photography of burning strands is limited to less than about 500 psig. The second investigation deals with the dependence of the subatmospheric pressure burning rates of 1/4 inch square strands of ammonium perchlorate propellants on pressure and oxidizer particle size. An apparatus providing for burning rate determination by sequence photography of the strands burning in an essentially stagnant nitrogen environment is detailed, and burning rate versus pressure results are included. C.T.C.

N66-10614*# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
STRESS-STRAIN BEHAVIOR OF AN INERT COMPOSITE PROPELLANT FOR MULTIAXIAL LOADING CONDITIONS Technical Report No. 2
M. G. Sharma and Y. S. Les Aug. 1965 42 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950875)
(NASA-CR-67809) CFSTI: HC $2.00/MF $0.50 CSCL 21I

Research was conducted to determine the mechanical characterization of an inert composite propellant for biaxial loading conditions from its observed behavior under uniaxial tension loading. The effect of rate of loading on stress-strain behavior is considered. Experimental data are included on the behavior of the material under several biaxial stress fields for two rates of loading. The experimental data were compared with predicted values based on linear viscoelastic theory and finite viscoelastic theory. Results show that the effect of biaxial stress fields reduces the extension ratios in either tangential or axial directions. Mechanical behavior is a border line case where both linear and finite viscoelastic theories may apply and is somewhat substantiated by predictions based on linear viscoelastic theory. For a stress ratio of 1.681, predicted and experimentally determined axial stress-strain curves compare well. Deviations are great between experimental and theoretical values for unaxial tension for a stress ratio of 0, but are reasonably good for stress ratios of 0.824 and 1.288. R.N.A.

N66-10844# Phillips Petroleum Co., Bartlesville, Okla.
THERMAL STABILITY OF HYDROCARBON FUELS Technical Documentary Report, 1 Jun. 1965–31 May 1965
Lucien Bagnetto Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Aug. 1965 122 p refs
(Contract AF 33(657)-10639)
(APL-TDR-64-89, Pt. II; AD-621531)

A program to investigate the effect of storage time and temperature on changes in thermal stability quality as measured by the CRC-Modified Fuel Coker (Supersonic Fuel or SSF) for five widely different fuel types revealed no significant deterioration of any fuels after 36 weeks at ambient field condition or 22 weeks at 130° F. After storage up to 36 days at 180° F four fuels showed no loss in thermal stability, but an HF alkylate fuel, containing about 2 percent olefins, showed a significant loss after only 6 days at 180° F. Removal of dissolved oxygen (to less than one part per million) from the HF alkylate fuel prior to storage prevented deterioration. Phillips' small scale (5-ml Bomb) procedure, developed to measure changes in fuel thermal stability quality, was found to correlate satisfactorily with the ASTM-CRC (Standard) Fuel Coker for ASTM Type-A distillate fuels. The amount of dissolved oxygen in fuels has been found to affect, significantly, thermal stability quality as measured by the 5-ml Bomb and the Fuel Cokers. Removal of dissolved oxygen from fuels of low and average thermal stability invariably resulted in gross improvements. Only slight improvements were found after removing dissolved oxygen from fuels of very high thermal stability quality. Author (TAB)

N66-10893# Stanford Research Inst., Menlo Park, Calif.
VISCOELASTIC PROPERTIES OF SOLID PROPELLANTS AND PROPELLANT BINDERS Quarterly Technical Summary Report No. 15 (Report No. 3 for Contract Period), 16 Mar.–15 Jun. 1965
N. W. Tschoegl and J. R. Smith [1965] 18 p ref
(Contract NOw-65-0061-d; ARPA Order 22)
(Rept.-15; AD-470846)

Data were obtained on the dependence of the shear moduli of a polyurethane propellant on shear strain at different frequencies and temperatures, and on the time of storage at low temperatures. The propellant was then tested in the dynamic shear tester over extended ranges of temperature and frequency. The data are presented in graphical form. Investigation of the problem of the variation of output with piston position and diaphragm configuration in the dynamic compressibility apparatus was continued. Author (TAB)

N66-10904# Joint Publications Research Service, Washington, D. C.
VAPOR TOXICITY OF A NEW ANTIDETONATOR–MANGANESE CYCLOPENTADIENYLTRICARBONYL
O. G. Arkhipova, M. S. Tolgskaya, and T. A. Kochetkova 3 Nov. 1965 6 p Transl. into ENGLISH from Gigiena i Sanit. (Moscow), no. 4, Apr. 1965 p 36–39
(JPRS-32705; TT-65-33184) CFSTI: $1.00

A maximum permissible concentration of 0.0001 mg/liter has been adopted for vapors of the antidetonating agent manganese cyclopentadienyltricarbonyl (MCT). MCT is found to be toxic at low concentrations and exhibits pronounced cumulative effects. At the level of 0.1 mg MCT per liter of air, a single application is lethally hazardous; at the 0.01 level severe and fatal intoxication is induced upon repeated administrations. Functional changes in the nervous system and incipient morphological changes in respiration results from concentrations at the 0.001 level. MCT produces irritation at the site of application, but does not penetrate the skin when used in solutions of oil and gasoline. Toxicity of MCT increases when tetrahydrofuran is used as a solvent; undamaged skin is penetrated and intoxication induced. M.W.R.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N66-10409*# National Aeronautics and Space Administration, Washington, D. C.
PROJECT OF A HIGH-ENERGY STANDARD PROPULSION UNIT FOR THE ELDO-B LAUNCH VEHICLE [DAS PROJEKT EINES HOCHENERGETISCHEN EINHEITSTRIEBWERKES FUR DIEELDO-B TRAGERRAKETEW]
Otfried Stumpf Oct. 1965 26 p Transl. into ENGLISH of Paper No. 1719 Presented at 5th European Spaceflight Symp., Munich, 19–22 Jul. 1965
(NASA-TT-F-9708) CSCL 21H

The ELDO (European Launcher Development Organization) development project for a 6-Mp hydrogen/oxygen rocket engine, to be used as standard propulsion unit for the high-energy upper stages of the series of ELDO-B launch vehicles, is described, with schematic sketches of single-engine arrangement in the third stage and four-engine clustering in the second stage of the three-stage launch vehicle. The specific impulses in vacuum (438.5 kp/sec/kg) and on liftoff, with preferential use of the pyrotechnic ignition method, are plotted. The pyrotechnic method offers the advantage of accelerated start of the turbopumps by the combustion gases of the powder trains and of elimination of an additional hydrogen pressurized tank. The thermodynamic principles, design data with two turbopumps, and future development prospects are given. A future project of a third (ELDO-C) three-stage variant, with a liftoff mass of 210 tons and a cluster of six engines in the second stage is described briefly, with plotted values of the thrust runup in the second and third stages. Author

N66-10416* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MATERIALS PROBLEMS IN SPACE-VEHICLE ENGINE DEVELOPMENT
Robert A. Boundy 22 Aprl. 1960 20 p refs
(Contract NASw-6)
(NASA-CR-67825; JPL-TR-32-22) CFSTI: HC $1.00/MF $0.50 CSCL 21H (Declassified)

Materials problems associated with the design, development, and fabrication of a 6000-lb-thrust tube-bundle liquid-propellant rocket engine are discussed. Particular emphasis is given to thrust-chamber fabriction, including the development of stainless steel tubes and the brazing techniques. Incidental aspects of fabrication are discussed, including the exit skirt, stiffener rings, wire wrapping, and chamber coating. Finally, future developments in the areas of tube fabrication and an uncooled extension nozzle are considered. Author

N66-10636*# Space-General Corp., El Monte, Calif.
STUDY OF SELECTED THRUST VECTOR CONTROL SYSTEMS FOR SOLID PROPELLANT MOTORS Final Report, 2 Jun.–2 Aug. 1965
Aug. 1965 182 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951189)
(NASA-CR-67659; SGC-884-FR-1) CFSTI: HC $5.00/MF $1.25 CSCL 21H

Analyses are given for liquid injection systems, auxiliary hot or cold gas systems, and gimballed nozzle systems to determine the size of each type of system required to overcome the maximum possible moment due to thrust misalignment. Within each category several variations of propellant and pressurization systems are considered. The systems are evaluated on the basis of weight, reliability, space storability, and state of development. The most suitable system of each type was selected, and a design layout made. The layouts are shown and the properties of the three systems are tabulated. Based on a derived thrust-time profile and spacecraft c.g. maximum moments in pitch, yaw, and roll are determined. C.T.C.

N66-10650*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GENERANT CONTROLLER DEVELOPMENT FOR THE ADVANCED LIQUID PROPULSION SYSTEM (ALPS)
W. F. Mac Glashaw, Jr. 15 Nov. 1965 35 p refs
(Contract NAS7-100)
(NASA-CR-67842; JPL-TR-32-814) CFSTI: HC $2.00/MF $0.50 CSCL 21H

The function of the generant controller is to meter the flow of hydrazine to the gas generator so that constant pressure is maintained in the propellant tank during all firing periods regardless of variations in the rates at which propellants flow out of the tank. The generant controller is essentially a remote-sensing, single-stage, spring-loaded regulator. Four controller versions were built and tested. Controlled 4 incorporates the best features of the preceding three controllers. Results of water tests that simulate expected operating conditions are recorded. Special features of these controllers, such as the diaphragm backup ring and the Belleville spring package which were developed as a result of this study, are discussed. The suitability of these special features for scalability and for other components is pointed out. An Appendix is included which describes the function of the generant controller in the ALPS system and in the Mariner '66 system. Author

N66-10671*# Allied Research Associates, Inc., Concord, Mass.
A PHOTOMECHANICAL INVESTIGATION OF THE ALGOL SOLID PROPELLANT ROCKET MOTOR NOZZLE Final Report
Herbert Becker and Harold Hamilton May 1965 84 p refs
(Contract NAS1-3975)
(NASA-CR-66026; ARA-F-274-8) CFSTI: HC $3.00/MF $0.75 CSCL 21H

A photoelastic investigation was conducted on scaled models of the Algol IIA and IIB rocket engine nozzles to determine pressure and thermal stresses, to compare theory with experiment, and to obtain a physical understanding of the structural behavior of the nozzle. Results of tests on the three-dimensional nozzle model under internal pressure applied to the entrance cone and extending downstream as far as the throat indicated much lower stresses than obtained from a theoretical analysis bases on a modification of shell theory. Two-dimensional models were employed to determine the relation between bending moment and stress throughout a longitudinal section of the nozzle. The experimental data agreed well with the predictions of elementary composite beam theory generated for this purpose. Photothermoelastic investigations performed on the two-dimensional models demonstrated that the maximum thermal stresses in the nozzle would be expected in the early stages of firing (within 10 seconds after ignition) and would be more than double the stresses calculated from a simplified thick-walled cylinder thermoelastic analysis. Author

N66-10689*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CALCULATION OF ROCKET PERFORMANCE PARAMETERS BASED ON THE EQUILIBRIUM COMPOSITION OF THE COMBUSTION PRODUCTS
Klaus W. Gross 27 Aug. 1965 173 p refs
(NASA-TM-X-53334) CFSTI: HC $5.00/MF $1.00 CSCL 21H

The theory is developed and essential equations are derived for calculating frozen and shifting equilibrium compositions of the combustion products of a rocket engine. The equilibrium composition of the combustion products is used as a basis for rocket performance calculations. The physical equations of a computer program and pertinent flow charts are also presented to enable individual programming. Author

N66-10795# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
GRAPHITE NOZZLE TESTING IN A SOLID PROPELLANT VARIABLE PARAMETER ROCKET ENGINE
Anthony K. Wong and Albert P. Levitt Jun. 1965 19 p refs (AMRA-TR-65-12; AD-620139)

Although many candidate nozzle materials have been test fired in rocket static test engines, the majority of these tests have never been correlated because of lack of an established basis for comparison. In view of the complex nature of erosion, no acceptable substitute has been found for firing tests in solid propellant engines. A static test engine capable of simply, systematically, and economically firing nozzles has been developed for the purpose of providing extensive data on nozzle erosion over a wide range of operating conditions. This data will provide the basis for a better understanding of nozzle erosion mechanisms. Initial tests with this engine indicate the feasibility of testing small graphite rocket nozzles at discrete pressure intervals up to 1600 psig and burning times up to 65 seconds. Author (TAB)

N66-10899# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT ENGINE ASSEMBLY
V. N. Belikov and A. N. Nikitin 26 Aug. 1965 296 p refs Transl. into ENGLISH of "Sborka Aviatsionnykh Dvigatelei" Moscow, Izd. Mashinostr., 1965 p 1–221
(FTD-MT-64-515; AD-620833)

This book contains information about basic types of connections used in the assembly of aircraft engines, and methods of making them. Data is presented on designing and organization of the technological process of assembly. Questions of accuracy of assembly are considered. Preparatory operations are described and examples are given of subassembly and general assembly of several types of engines. The book is a training aid for students of aviation institutes and departments. It can also present interest for engineering and technical workers of the aviation industry. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N66-10158*# National Aeronautics and Space Administration, Washington, D. C.
ACTINOMETRY
K. Ya. Kondrat'yev Nov. 1965 687 p refs Transl. into ENGLISH of the book "Aktinometriya" Leningrad, Gidrometeorologicheskoye Izdatel'stvo, 1965
(NASA-TT-F-9712) CFSTI: HC $9.87/MF $3.25 CSCL 20H

Information is presented on the laws of transfer of radiant energy in the atmosphere and on the radiation regime of the atmosphere and the Earth's surface. Included are brief discussions of the most important problems involved in the methods of actinometric measurements. The material in this publication is intended for use by students in hydrometeorological institutes and departments at universities specializing in meteorology and atmospheric physics. Subject areas covered include radiant energy, methods of actinometric observations, radiation absorption and scattering in the atmosphere, direct solar radiation, scattered atmospheric radiation, albedo of the underlying surface and clouds, total radiation, thermal radiation of the atmosphere, radiation balance, and change of atmospheric temperature associated with radiant heat exchange. R.R.D.

N66-10244* Bell Telephone Labs., Inc., Murray Hill, N. J.
THE ENERGETIC PARTICLE ENVIRONMENT OF RELAY I
W. L. Brown, L. W. Davidson, and L. V. Medford *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 403–427 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1678)

Two semiconductor p–n junction particle detectors are used to evaluate energetic particle environment encountered by the Relay I spacecraft, and to provide information of trapped radiation belts. One of the detectors measures electrons with energies above approximately 1 Mev; the other measures protons in the 2.5 to 8 Mev region. Electron measurements over a seven month period, which correlate well with those made on Explorer XV, are characterized by a stable high intensity inner belt and a relatively unstable outer belt. Flux of low energy protons reaches a single maximum at an equatorial value of L of about 1.9 earth radii for protons of about 5 Mev, and 2.1 earth radii for 2.5 Mev. These low energy protons, which have an extremely high damage rate per particle in semiconductor materials, are responsible for most of the damage sustained by Relay I during experiments with unshielded solar cells. Observed maximum damage rates coincide with periods during which the satellite is in or near the maximum in proton distribution. M.W.R.

N66-10245* California Univ., La Jolla.
RELAY I TRAPPED RADIATION MEASUREMENTS
C. E. Mc Ilwain, R. W. Fillius, J. Valerio, and A. Dave *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 429–447 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NASr-116)

The spatial dependence of the intensities of geomagnetically trapped electrons with energies greater than 0.45 Mev and of protons in four energy ranges have been measured in the region within radial distances of 1.2 and 2.3 earth radii. Author

N66-10246* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE RELAY I RADIATION EFFECTS EXPERIMENT
R. C. Waddel *In its* Relay I Program 1965 p 449–468 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

Solar cells on Relay I were monitored for radiation damage by measurement of short circuit current. The orbit was 1321 km perigee, 7439 km apogee, 47.5 degrees inclination. Unshielded N/P, P/N, and gallium arsenide cells degraded in 10 days to 52%, 28%, and 18%, respectively. This damage is ascribed to low energy protons. At 300 days silicon N/P and P/N cells, shielded with 30 mils of fused silica, degraded to 73% and 53%, respectively. At 300 days silicon N/P and P/N cells, shieded with 60 mils of fused silica, had degraded to 80% and 61%, respectively. Available space flux maps predicted somewhat greater damage to the heavily shielded cells, from either electrons or high energy protons, than that observed. The minority carrier lifetime of some silicon diodes declined to 50% in about 45 days. Author

N66-10365# National Bureau of Standards, Washington, D. C.
CONFERENCE ON NON-LINEAR PROCESSES IN THE IONOSPHERE

Donald H. Menzel and Ernest K. Smith, Jr., ed. 17 Apr. 1964 88 p refs Conf. held 16–17 Dec. 1963
(NBS-TN-211, Vol. 1) GPO: $0.50

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2. ON SOME NON-LINEAR PHENOMENA IN THE IONOSPHERIC PLASMA P. Caldirola and O. De Barbieri (Milan Univ.) p 27–83 refs (See N66-10367 01-29)

N66-10366 Harvard Coll. Observatory, Cambridge, Mass.
THE GENERAL PROBLEM OF IONOSPHERIC NONLINEARITIES
Donald H. Menzel *In* Natl. Bur. of Std. Conf. on Non-Linear Processes in the Ionosphere 17 Apr. 1964 p 1–25 refs (See N66-10365 01-29) GPO: $0.50

Nonlinear disturbances in an electric field that varies with time produce a total effect depending on the cross-product of the individual disturbances. Interactions of acoustic waves from a radio transmitter with electromagnetic waves in the ionosphere result in acoustic disturbances. The amount of cross modulation depends on: the electron density and temperature, the frequency of dissipative electron collisions, and the magnetic field that fixes the electron gyrofrequency. Examination of the basic wave equation shows also that a single modulated wave in the ionosphere may interact with itself. Detailed mathematical calculations on the various nonlinear effects of acoustic wave interactions with electromagnetic fields of the ionosphere are included. G.G.

N66-10367 Milan Univ. (Italy) Inst. of Physical Science.
ON SOME NON-LINEAR PHENOMENA IN THE IONOSPHERIC PLASMA
P. Caldirola and O. De Barbieri *In* Natl. Bur. of Std. Conf. on Non-Linear Processes in the Ionosphere 17 Apr. 1964 p 27–83 refs (See N66-10365 01-29) GPO: $0.50

The electron distribution function of a slightly ionized plasma under the influence of an external magnetic field, and of an electromagnetic wave of the type $\underline{E} = \underline{E}_0 \cos \omega t$, was calculated by taking into account both the elastic and inelastic collisions between electrons and molecules. It was shown that the components of the complex dielectric permittivity tensor can be simplified if $\underline{E}_0$ is sufficiently small, and the nonlinear dispersion relation can be obtained. This relation becomes the Appleton-Hartree formula for $\underline{E}_0 \to \underline{0}$. Also calculated were the electronic distribution function and the complex dielectric permittivity tensor for a wave of the type $\underline{E} = \underline{E}_0[1 + \eta\cos(\alpha t + \beta)]\ \cos\omega t$ with $\omega \simeq \omega_H >> \alpha$. G.G.

N66-10582# Joint Publications Research Service, Washington, D. C.
GRAVITATIONAL RADIATION OF EXPLOSIVE ORIGIN
L. M. Ozernoy 22 Oct. 1965 6 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. II, no. 2, 15 Jul. 1965 p 83–87
(JPRS-32513; TT-65-32992) CFSTI: $1.00

An estimate is made of the intensity of gravitational radiation arising from the explosive escape of matter during explosions of quasi-stellar radio sources, explosions of galaxies, collisions of stars in the nuclei of radio galaxies, and explosions of Supernovae and Novae. It is observed that explosive gravitational radiation in these processes is considerable. E.E.B.

N66-10672*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
MAGNETOSPHERIC PHENOMENA
Juan G. Roederer Sep. 1965 25 p refs Presented at 9th IUPAP Intern. Conf. on Cosmic Rays, London, 6–17 Sep. 1965
(NASA-TM-X-55300; X-640-65-423) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A qualitative discussion is presented describing the physical processes involved in magnetospheric phenomena. The shape and structure of the magnetosphere is discussed in terms of solar wind, stationary shock wave, transition region, magnetopause, and the distorted field in the outer magnetosphere. Also examined are the motion of charged particles in the magnetosphere and geomagnetically trapped radiation. R.N.A.

N66-10681*# RAND Corp., Santa Monica, Calif.
ON THE FLOW OF A MAGNETIZED SOLAR WIND AROUND THE MOON
J. R. Jokipii Sep. 1965 13 p refs
(Contract NASr-21)
(NASA-CR-67820; RM-4714-NASA) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The effects of interplanetary magnetic fields on the flow of plasma around the moon are considered. If the moon possesses a negligible magnetic field, and if the conductivity of the moon is not appreciably less than 10^6 sec^{-1} in Gaussian units, a crude analysis indicates that most of the solar wind is deflected around the moon and only a small fraction actually strikes the lunar surface. Consequences for recent models of the lunar atmosphere are briefly discussed. Author

N66-10684*# Northrop Space Labs., Hawthorne, Calif.
ENGINEERING STUDY TO DETERMINE FEASIBLE METHODS OF SIMULATING PLANETARY ALBEDO AND RADIATION EFFECTS UPON THE THERMAL BALANCE OF SPACECRAFT Final Report
Constantino Cafaro, Merl K. Fairchild, Herbert J. Harris, Arnold P. Shlosinger, and Vincent M. Urban Jan. 1965 168 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950829)
(NASA-CR-67813; NSL-65-5) CFSTI: HC $5.00/MF $1.00 CSCL 20H

This report presents the results of an engineering study and analysis to determine the effects of planetary albedo and radiation from Mars and Venus on the thermal balance of spacecraft orbiting these planets, and to study feasible methods of simulating Mars and Venus planetary albedo and radiation in a space simulation chamber. The existing literature for Mars and Venus provides a multiplicity of planetary albedo values. This study used the range of published albedo values to effectively bound the thermal effects on vehicles orbiting these planets. The results of the thermal analysis indicate that the effects of planetary albedo and radiation are significant. Therefore, the albedo and radiation should be considered in the design and test of spacecraft whose mission includes close orbit of these planets. The extreme variation of environment for Mars and Venus and the conflicting simulation features desired for planetary radiation simulations makes it impractical to devise one simulator system for both Mars and Venus. Simulator design should be tailored to the specific requirements of the spacecraft and its mission. Author

N66-10878*# AVCO-Everett Research Lab., Everett, Mass.
A LIMIT ON STABLY TRAPPED PARTICLE FLUXES
C. F. Kennel and H. E. Petschek Jul. 1965 65 p refs Submitted for Publication
(Contracts NASw-837; Nonr-2524(00))
(NASA-CR-67725; AVCO-Everett Res. Rept.-219) CFSTI: HC $3.00/MF $0.75 CSCL 20H

Computations are worked out showing that the nonlinear behavior or weak turbulence in whistler and ion cyclotron noise modes involves the linear growth rate. The linear theory is reviewed. It is shown that the pitch angle anisotropy in steady state weak diffusion, from the whistler noise mode, is virtually a constant. Also calculated are the limiting proton and electron fluxes, which were shown to be roughly equal, suggesting a partial explanation for the existence of larger densities of high energy protons than electrons. The theoretical limiting flux limits were compared with Explorer XIV equatorial trapped fluxes as a function of the equatorial radial distance. The largest observed trapped fluxes were close to the theoretical limit. Also shown is the distribution of the L-shell of Injun III precipitated electrons. As expected, strong precipitation only occurred where trapped fluxes were comparable with the calculated limiting flux. L.S.

N66-10891# IIT Research Inst., Chicago, Ill.
RADIATION TRAPPED IN THE EARTH'S MAGNETIC FIELD Final Report
Billy M. Mc Cormak Sep. 1965 22 p Rept. of the Advanced Study Inst. held at Bergen, 16 Aug.–3 Sep. 1965
(Grants DA-ARO(D)-49-092-G67; Nonr(G)-00045-65)
(IITRI-T6118; AD-470117)

An Advanced Study Institute, Radiation Trapped in the Earth's Magnetic Field, was held August 16 through September 3, 1965, at the Bergen Technological School, Bergen, Norway. An opportunity was provided for the people working in the various research areas to conduct detailed discussions, and for a large number of European scientists to become familiar with space research. Author (TAB)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N66-10046*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
SATELLITE MOTION FOR ALL INCLINATIONS AROUND AN OBLATE PLANET
M. Eckstein, Y. Shi, and J. Kevorkian Aug. 1964 57 p refs Presented at IAU Symp., Thessaloniki, Greece, 17–22 Aug. 1964 *Its* Paper No. 3078
(Contract NASw-901; Grant AF-AFOSR-62-256)
(NASA-CR-67598) CFSTI: HC $3.00/MF $0.50 CSCL 22C

A uniformly valid solution for the motion of a satellite around an oblate planet is presented. The two variable expansion procedure as earlier developed was applied to obtain a solution valid for all inclinations including the critical. This solution is correct to order ϵ, where ϵ is a small parameter proportional to the oblateness parameter J_2. The reciprocal of the radius vector, eccentricity, perigee, inclination, and node of the satellite orbit are given as functions of the central angle ϕ between node and satellite. The results are based on a potential which includes the second and fourth zonal harmonics. The solution for the case of critical inclination is first obtained separately and then matched with the solution of the noncritical case to establish a solution uniformly valid for all inclinations. Author

N66-10048*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE ULTRAVIOLET SPECTROSCOPY OF PLANETS
Charles A. Barth [1965] 261 p refs
(NAS7-100)
(NASA-CR-67597) CFSTI: HC $5.00/MF $1.00 CSCL 03B

The theory of the twilight and day airglow is discussed and the ultraviolet spectroscopy of a planetary atmosphere is described. The ultraviolet albedo of the earth is shown in the wavelength range 1900 Å to 3200 Å. The spectrum was obtained from an attitude-controlled rocket at an altitude of 168 km while the scanning spectrometer was aimed at a zenith angle of 180° directly downward at the atmosphere. The solar spectral features and the absorption produced by ozone in the earth atmosphere are given. Tables are given for the following: (1) atoms that may undergo resonance reradiation in planetary atmospheres; (2) molecules that may undergo fluorescence in planetary atmospheres; (3) molecules that may undergo absorption in planetary atmospheres; (4) planetary atmospheres molecular emission factors; and (5) intense bands for systems studied. Each of these phenomena are considered in detail. E.E.B.

N66-10050*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THE APPLICATION OF FLOQUET THEORY TO THE COMPUTATION OF SMALL ORBITAL PERTURBATIONS OVER LONG TIME INTERVALS USING THE TSCHAUNER–HEMPEL EQUATIONS
Benjamin O. Lange and Robert G. Smith Aug. 1965 74 p refs (Grant NsG-582)
(NASA-CR-67578; SUDAER-241) CFSTI: HC $3.00/MF $0.75 CSCL 22C

A method of calculating the deviation of the path of an orbiting body from a nominal or reference trajectory is presented. Derivation of the Tschauner–Hempel equations; review of the Floquet theory; and the solution of constant, periodic, and almost periodic perturbing accelerations are included. E.E.B.

N66-10073# Joint Publications Research Service, Washington, D. C.
SIBERIAN CENTER FOR STUDIES IN ASTRONOMY
B. Konovalov and L. Shinkarev 22 Oct. 1965 7 p Transl. into ENGLISH from Izvestiya (Moscow), no. 181, 3 Aug. 1965 p 3 (JPRS-32522; TT-65-33001) CFSTI: $1.00

Descriptions are presented of various Siberian centers for astronomical studies, the instrumentation used, and scientific investigations being conducted. R.N.A.

N66-10102 Joint Publications Research Service, Washington, D. C.
RADIO EMISSION FROM THE MOON AND THE SUN AT A WAVELENGTH OF 1.3 mm
L. I. Fedoseyev *In its* News of Higher Educational Inst. 28 Feb. 1964 p 1–12 refs (See N66-10101 01-23) CFSTI: $6.00

A radio telescope with a directivity pattern 10 to 12 min wide was used to measure, at a wavelength of 1.3 mm, the temperature of the radio emission of the central part of the moon's

disk as a function of its phases. It is found that the radio brightness of the moon T_M varies during the lunation in accordance with a given law. The radio temperature of the sun, measured at 1.3 mm, was found to be 6700 ±700° K. Author

N66-10103 Joint Publications Research Service, Washington, D. C.
RESULTS OF OBSERVATION OF RADIO SPOTS ON THE SUN AT A WAVELENGTH OF 5 METERS
L. I. Matveyenko *In its* News of Higher Educational Inst. 28 Feb. 1964 p 13–33 refs (See N66-10101 01-23) CFSTI: $6.00

Results are reported of observations of radio spots on the sun at a wavelength $\lambda = 5$ meters carried out in June 1960. The dimensions, shape, and effective temperature of the radio spots, as well as the trajectories and their rate of motion are all given. Author

N66-10104 Joint Publications Research Service, Washington, D. C.
FLUCTUATIONS OF THE RADIO EMISSION FROM THE ATMOSPHERE
K. S. Stankevich and L. N. Bondar *In its* News of Higher Educational Inst. 28 Feb. 1964 p 34–43 refs (See N66-10101 01-23) CFSTI: $6.00

The mean square fluctuation of the temperature of the radio emission of the atmosphere is calculated on the basis of the turbulent mixing model. Author

N66-10121 Joint Publications Research Service, Washington, D. C.
RADIO EMISSION FROM THE MOON AND THE SUN AT 1.8 MILLIMETERS
I. A. Naumov *In its* News of Higher Educational Inst. 28 Feb. 1964 p 368–371 refs (See N66-10101 01-23) CFSTI: $6.00

The intensities of radio emission from the moon were measured at a wavelength of 1.8 mm from an altitude of 3860 meters above sea level. The radio temperature of the moon is plotted against its optical phase. The deviation of the majority of the experimental points did not exceed 10 to 15%. The phase dependence of the radio emission from the moon agrees with the deductions of the theory of the single-layer model. Also, measurements of the intensity of the radio emission from the sun yielded the following results:

$$T_s = 6500 \pm 700^\circ \text{ K}$$

which agrees with previously published data. E.E.B.

N66-10127 Joint Publications Research Service, Washington, D. C.
FOURTH ALL-UNION SCIENTIFIC CONFERENCE ON RADIO ASTRONOMY
S. A. Kaplan, V. V. Zaystev, A. G. Kislyakov, M. M. Korbrin, and N. M. Tseytlin *In its* News of Higher Educational Inst. 28 Feb. 1964 p 394–412 (See N66-10101 01-23) CFSTI: $6.00

The conference covered all aspects of radio astronomy. Among the subjects summarized are the following: *Metagalactic Cosmic Rays and Magnetic Fields; Radio Stars; Observational Verification of Cosmological Theories; Acceleration of Electrons by Plasma and Electromagnetic Waves, Observation of Cosmic Radio Emission; Polarization of Cosmic Radio Emission; Polarization of the Crab Nebula; Magnetic Fields of Interplanetary Space; Radio Emission from the Sun; Radio Emission of the Moon; Infrared Emission from the Moon;* and *Radio Astronomic Apparatus.* E.E.B.

N66-10130# Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
ARTIFICIAL EARTH SATELLITES Observations and Investigations in Poland
Roman Teisseyre, ed. Polish Sci. Publishers, 1965 141 p refs CFSTI: HC $4.00/MF $1.00

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10. CONTRIBUTIONS OF SATELLITE METHOD TO THE GRAVIMETRICAL AND GEOMETRICAL MEASUREMENTS J. Zielinski (Warsaw Univ.) p 95–103 refs (See N66-10140 01-30)

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13. THE PROBLEM OF SATELLITIC TRILATERATION W. Baran p 133–135 (See N66-10143 01-30)

N66-10131 Polish Academy of Sciences, Warsaw.
THE ARTIFICIAL SATELLITE (POLISH OPTICAL OBSERVATIONS AND RESEARCHES)

Ludoslaw Cichowicz *In its* Artificial Earth Satellites 1965 p 3–5 (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

The Polish program of exploration of space has been confined to the observations of artificial satellites and research based upon the data from these observations. The Polish satellite service consists of 12 stations, most of which are associated with the universities or scientific geodetic centers. Thirty thousand observations of artificial satellite positions have been made since 1957. The results of these observations are transmitted to Moscow. The collaboration program with the Soviet Union is discussed. The two main subjects of this collaboration have been on the geodetic satellites Echo I and Echo II and on the study of atmospheric structure from the Cosmos satellites. E.E.B.

N66-10132 Warsaw Univ. (Poland). Astronomical Observatory.

THE DIFFERENCE METHOD OF THE VISUAL OBSERVATIONS OF THE ARTIFICIAL SATELLITE WITH THE THEODOLITE WILD T3 ADAPTED

Maciej Bielicki *In* Polish Acad. of Sci. Artificial Earth Satellites 1965 p 7–11 (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

A method for the observing of artificial satellites is presented and the corrections to the instrumentation are discussed. Estimates of accuracy of measurements are given and the instrument used for the observations is described. E.E.B.

N66-10133 Warsaw Univ. (Poland). Astronomical Observatory.

ON THE NUMERICAL METHOD OF DETERMINING THE INNER GENERAL MEAN ERROR OF A OBSERVATIONAL POSITION IN SERIES OF THE ARTIFICIAL SATELLITE

Maciej Bielicki *In* Polish Acad. of Sci. Artificial Earth Satellites 1965 p 13–18 (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

Equations are given for the determination by numerical methods of the inner general mean error of an observation in a series of satellite measurements. All formulae are written in equatorial coordinates. An example of the method is given for the observations of the Echo I satellite. Time moments and satellite positions are tabulated. E.E.B.

N66-10134 Polish Academy of Sciences, Warsaw. Poznan Astronomical Observatory.

PHOTOGRAPHIC OBSERVATIONS AT STATION NO. 1154 IN POZNAN

Hieronim Hurnik *In its* Artificial Earth Satellites 1965 p 19–23 (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

The general astrometric character of the work of the Observatory and the observations of the Echo satellites for the purpose of satellite triangulation are discussed. Also, the development of a special photographic camera with automatic registration is described in detail. E.E.B.

N66-10135 Warsaw Univ. (Poland). Astronomical Observatory.

DETERMINATION OF EQUATORIAL POSITIONS OF ARTIFICIAL SATELLITES BY MEASUREMENT OF PHOTOGRAPHIC PLATES AND TAKING ADVANTAGE OF SPHERICAL ANGLE

Jan Latka *In* Polish Acad. of Sci. Artificial Earth Satellites 1965 p 25–38 refs (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

A method is presented for the determination of the positions in space of artificial satellites by photographic recordings and the equations of spherical geometry. E.E.B.

N66-10136 Polish Academy of Sciences, Warsaw. Computation Centre.

THE SATELLITE COMPUTATIONS IN THE COMPUTATION CENTRE OF THE POLISH ACADEMY OF SCIENCES

Wojciech Pachelski *In its* Artificial Earth Satellites 1965 p 39–56 refs (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

A method is presented for the computation of ephemerides for artificial satellites. Ephemerides were computed for the ionospheric satellite Alouette. Also, an improvement of orbital elements for the Cosmos-3 satellite is given which is based on a large number of low accuracy optical observations. The computer program for the satellite ephemeride computations is included. E.E.B.

N66-10137 Warsaw Univ. (Poland). Astronomical Observatory.

NOMOGRAMS AND DIAGRAMS FOR DETERMINATION OF EPHEMERIDES OF ARTIFICIAL EARTH SATELLITES

Jan Bieniewski and Stanislaw Domaradzki *In* Polish Acad. of Sci. Artificial Earth Satellites 1965 p 57–60 (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

Nomograms and diagrams for the determination of topocentric position of satellite altitude are given for the case when the geographic coordinates of a subsatellite point and the height of the satellite for a given instant of time are known. The accuracy of the extrapolated coordinates of subsatellite point is of the order of 0.1° to 0.5° and the accuracy of the corresponding time exceeds one minute. The accuracy of the satellite altitude is of the order of several km. Therefore, the ephemeride computation accuracy should not be expected to be better than 0.5°. By comparison the accuracy of the nomograms and diagrams is of the order of 0.1° to 0.3° and the time for the determinations is shortened nearly tenfold. E.E.B.

N66-10138 Nicolaus Copernicus Univ., Torun (Poland). Astronomical Observatory.

PERIODIC ORBITS OF ARTIFICIAL SATELLITES OF EARTH DETERMINED BY MEANS OF THE LAPUNOW-DUBOSHIN METHOD

S. Gaska *In* Polish Acad. of Sci. Artificial Earth Satellites 1965 p 61–81 refs (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

The general solution and the coefficients for the periodic solution of the Lapunow-Duboshin equations are presented for the periodic orbits of artificial earth satellites. E.E.B.

N66-10139 Warsaw Univ. (Poland). Astronomical Observatory.

DETERMINATION OF THE HEIGHT OF A CIRCULAR SATELLITE FROM A SINGLE OBSERVATION OF ITS COORDINATES AND THEIR DERIVATIVES WITH RESPECT TO THE TIME

Jerzy Boryczka *In* Polish Acad. of Sci. Artificial Earth Satellites 1965 p 83–93 (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

The height of a satellite in circular orbit is determined from a single observation of its coordinates and their derivatives with respect to time. The calculations are given for Sputnik 4, Rocket 25; and for Echo I. The height of the former was found to be 273 km and the height of the latter was calculated to be 1655 km. The maximum error for the height resulting from the assumption of the circularity of the orbit is also calculated. E.E.B.

N66-10140 Warsaw Univ. (Poland). Astronomical Observatory.
CONTRIBUTIONS OF SATELLITE METHOD TO THE GRAVIMETRICAL AND GEOMETRICAL MEASUREMENTS
Janusz Zielinski *In* Polish Acad. of Sci. Artificial Earth Satellites 1965 p 95–103 refs (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

The geometrical method for defining the size and general shape of the earth; the gravimetric method for determining the general as well as the detail shape of the geoid; and the satellite method for accurate determination of the general shape of the earth are discussed and the combination of these three methods for accurate information about the earth shape are considered. E.E.B.

N66-10141 Polish Academy of Sciences, Warsaw.
TAKING ADVANTAGE OF SYNCHRONICAL POSITIONAL OBSERVATIONS OF AN ARTIFICIAL SATELLITE OF THE EARTH TO DETERMINE ITS GEOCENTRIC AND TOPOCENTRIC DISTANCES
Wlodzimierz Baran *In its* Artificial Earth Satellites 1965 p 105–119 refs (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

General formulae for the determination of geocentric and topocentric distances from observations of artificial satellites are derived and applications of the formulae are given. Also, the influence of the geometrical conditions and the accuracy of position observations on the magnitude of the error in determining geocentric distances are considered. E.E.B.

N66-10142 Polish Academy of Sciences, Warsaw.
THE ADJUSTMENT AND CALCULATION OF THE SATELLITE TRIANGULATION
Stanislaw Milbert *In its* Artificial Earth Satellites 1965 p 121–132 (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

Equations are derived for the adjustment and calculation of the directions between stations in satellite triangulation. Also, if the exact values of astronomic coordinates are known, the components of the deviation of the vertical and the geodesic coordinates can be calculated from the formulae which are given. E.E.B.

N66-10143 Polish Academy of Sciences, Warsaw.
THE PROBLEM OF SATELLITIC TRILATERATION
Wlodzimierz Baran *In its* Artificial Earth Satellites 1965 p 133–135 (See N66-10130 01-30) CFSTI: HC $4.00/MF $1.00

The synchronous measurement of the topocentric distances of an artificial satellite from three points is discussed and equations are presented which permit the determination of the position of the satellite. Also, knowing the position of the satellite, the same equations may be used to determine the position of one of the stations on the surface of the earth. Equations for such triangulation problems are given. E.E.B.

N66-10145# Boeing Scientific Research Labs., Seattle, Wash.
THE FIGURE AND GRAVITY FIELD OF THE MOON
C. L. Goudas Mar. 1965 204 p refs *Its* Mathematical Note No. 387

The document constitutes an effort to relate all existing figure data of the moon obtained both from its face and its marginal zone, with the better known dynamical properties of the lunar body established from the study of its kinetic behavior around the center of mass. Author

N66-10170# Martin Co., Orlando, Fla. Technical Information Center.
RADIO ASTRONOMY, A SELECTED BIBLIOGRAPHY
Lucille Mc Clure 22 Jun. 1965 50 p
(RB-125; AD-465566)

A selected bibliography on radio astronomy covering domestic and foreign publications is presented. The subject area includes the study of electromagnetic impulses of radio energy emitted by celestial bodies and regions, as well as the study of the universe by using radio waves instead of visible light frequencies. R.R.D.

N66-10219# Naval Weapons Lab., Dahlgren, Va.
FIRST ORDER PERTURBATIONS IN LONGITUDE FOR CIRCULAR POLAR SATELLITE ORBITS, DUE TO TESSERAL HARMONICS
Frederick F. Pearson Aug. 1965 32 p refs
(K-67/65; AD-620672)

This paper develops the first order perturbations in mean longitude for circular polar satellite orbits for a general tesseral harmonic of order m and degree *l*. The development proceeds along the line of the Gaussian form of the variational equations. Author (TAB)

N66-10322*# National Aeronautics and Space Administration, Washington, D. C.
METEORIC MATTER IN INTERPLANETARY SPACE
V. G. Fesenkov Nov. 1965 230 p refs Transl. into ENGLISH of "Meteornaya Materiya v Mezhduplanetnom Prostranstve" Moscow, Izd. Akad. Nauk SSSR, 1947
(NASA-TT-F-378) CFSTI: HC $6.00/MF $1.25 CSCL 03B

Theoretical and observational data concerning meteors and cosmic dust which give rise to zodiacal light are reviewed, and it is shown that their matter must have its origin primarily within the solar system, because the sun cannot capture interstellar matter. Also investigated are the nature of the earth's emissive layer, and the effect of hyperbolic meteors. In the latter case it is shown that their effect on zodiacal light is negligible. In addition a derivation of the distribution of meteors within the solar system, and in space was performed; and the motion of a dust particle in space, subject to the sun's attraction and light pressure is studied. The time required for a particle to fall into the sun from any distance is computed. Due to the photoeffect, the particle accumulates a charge, which is found not to influence its motion. L.S.

N66-10340*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-34, VOLUME IV FOR THE PERIOD JUNE 1, 1965 TO JULY 31, 1965. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
31 Aug. 1965 312 p refs
(Contract NAS7-100)
(NASA-CR-67637; JPL-SPS-37-34, Vol. IV) CFSTI: HC $7.00/MF $1.75 CSCL 22C

Articles and appropriate references on the following subjects pertinent to the NASA space exploration programs are presented: communications systems research (information, coding, and modulation and detection theory); space instruments; lunar and planetary sciences; chemistry; physics; fluid physics; liquid propulsion; solid propellant engineering; polymer research; space simulators and facility engineering; aerodynamic facilities; electromechanical engineering; applied mechanics; pure oxide ceramic research; guidance and control research; spacecraft control; spacecraft power; environmental requirements; scientific programming; and systems analysis. R.R.D.

N66-10341*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SPACE PROGRAMS SUMMARY NO. 37-35, VOLUME VI FOR THE PERIOD JULY 1, 1965 TO AUGUST 31, 1965. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES

30 Sep. 1965 49 p refs

(Contract NAS7-100)

(NASA-CR-67719; JPL-SPS-37-35, Vol. VI) CFSTI: HC $2.00/MF $0.50 CSCL 22B

A digest of material on the lunar program, the planetary-interplanetary program, and the deep space network is presented. Included are reports of technical supporting activities, engineering development of environmental-test facilities, quality assurance and reliability, and a reprint of the space science instrumentation studies. The subjects covered are: (1) the Surveyor Project; (2) the Mariner Project; (3) the Deep Space Instrumentation and Space Flight Operations Facilities; (4) environmental test facilities; (5) space instruments, and (6) physics. R.R.D.

N66-10342*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A PHOTOMETRIC METHOD FOR DERIVING LUNAR TOPOGRAPHIC INFORMATION

T. Rindfleisch 15 Sep. 1965 20 p refs

(Contract NAS7-100)

(NASA-CR-67718; JPL-TR-32-786) CFSTI: HC $1.00/MF $0.50 CSCL 22A

A general and rigorous treatment is given of the photometric method for deriving lunar surface elevation information from pictures of the surface. In the course of the derivation certain shortcomings inherent in the method are pointed out. The resulting equations are then applied to the *Ranger* pictures as part of a digital processing procedure and examples are given. Author

N66-10372# Smithsonian Astrophysical Observatory, Cambridge, Mass.

RESEARCH IN SPACE SCIENCE. ON THE PHYSICS AND SPLITTING OF COMETARY NUCLEI

Fred L. Whipple and Robert P. Stefanik 11 Aug. 1965 27 p refs Presented at the 13th Intern. Astrophys. Symp. on the "Nature and Origin of Comets", Cointe-Sclessin, Belgium, 5–7 Jul. 1965

(SAO Special Report-182)

This paper considers the effect of radioactive heating on an icy conglomerate cometary nucleus. The heat conductivity in such a body is extremely low and the surface temperatures required to radiate the heat generated for reasonable cometary dimensions are also very low, less than 10° K. Heat and mass transfer is effected in the early stages primarily by the sublimation in the core of the more volatile materials, such as CH_4, which diffuse outward and recondense near the surface of the nucleus. Although this process begins soon after formation, a thick outer crystalline shell is not formed generally until well after the nucleus has been perturbed into the great cometary cloud. After ejection into the cometary cloud the outer shell of the more volatile materials develops and thickens, leaving the comet with an external brittle shell and a core depleted of the more volatile constituents. During its long stay in "interstellar" space the comet is affected by practically no external physical forces. On its first close approach to the sun, however, it is for the first time exposed to strong external solar radiation and sublimation. This is a form of heat shock which may cause comets to split. Author

N66-10373# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

THE SELENODETIC CONTROL SYSTEM OF THE AERONAUTICAL CHART AND INFORMATION CENTER OF THE U. S. AIR FORCE

C. L. Goudas Jun. 1965 34 p refs *Its* Mathematical Note No. 413

(DI-82-0443)

Values of the coefficients J_{ij} and J'_{ij} of the expansion into spherical harmonics of the surface of the Moon as this is presented by the Selenodetic Control System of the Aeronautical Chart and Information Center, (ACIC), of the U. S. Air Force, are derived. Data for the Marginal Zone are taken from the maps of Watts and Hayn and the measurements of Davidson and Brooks. It is found that the present values are in good agreement with those derived on the basis of the same data derived by Schrutka–Rechtenstamm and the Army Map Service. The ACIC Control System approximates best the figure of the Moon as this is derived from the study of its physical liberation on the assumption of homogeneity. Author

N66-10411*# National Aeronautics and Space Administration, Washington, D. C.

THE FIRST EGRESS OF MAN INTO SPACE [PERVYY VYKHOD CHELOVEKA V KOSMICHESKOE PROSTRANSTVO]

A. A. Leonov Oct. 1965 7 p Transl. into ENGLISH of paper presented at the 16th Intern. Astronautics Cong., Athens, 13–18 Sep. 1965

(NASA-TT-F-9727) CFSTI: HC $1.00/MF $0.50 CSCL 22A

A personal account of the walk in space taken by the cosmonaut of the Voskhod-2 spacecraft is presented. Discussed are the rehearsal for the flight, the airlock and egress procedure, and the extravehicular activity executed with an autonomous back-pack life support system. It is observed that the conditions of extravehicular activity cause no specific changes in the state of the cosmonauts physiological functions. Physical preparedness and training before flight is very important. The activity experiment shows that it is possible for humans to perform certain work functions in space. L.S.

N66-10426*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

RESEARCH AND ADVANCED DEVELOPMENT. VOLUME I: SUPPORTING RESEARCH AND TECHNOLOGY FOR THE OFFICE OF SPACE SCIENCES AND APPLICATIONS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION Semiannual Review, 1 Jan.–30 Jun. 1965

15 Aug. 1965 409 p refs

(Contract NAS7-100)

(NASA-CR-67617; JPL-TM-33-243, Vol. 1) CFSTI: HC $7.00/MF $2.00 CSCL 22A

A review is presented of supporting research and technology in lunar and planetary exploration, physics and astronomy, bioscience, and manned space sciences. Developments are discussed on instrumentation, space chemistry, ionospheric and radio physics, planetology, planetary atmospheres, planetary quarantine sterilization, spacecraft and capsule equipment, spacecraft reliability, spacecraft testing equipment and techniques, planetary and interplanetary studies, magnetodynamics in space, energetic particles, sounding rocket experiments, exobiology, and lunar and planetary X-ray diffraction. R.N.A.

N66-10429*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DERIVATION OF PARAMETRIC VALUES FOR A GREENHOUSE MODEL OF THE CYTHEREAN ATMOSPHERE
Robert B. Owen 7 Sep. 1965 76 p refs
(NASA-TM-X-53327) CFSTI: HC $3.00/MF $0.75 CSCL 03B

Presented is a self-consistent model atmosphere for the planet Venus, with emphasis on parameters of general use in developing vehicle design criteria. Kern and Schilling's program for generation of atmospheric parameter values is coupled with the most recent estimates of surface conditions in order to derive the atmospheric environment at different altitudes. A range of initial values is used to produce a parametric band most representative of actual conditions. Because of the extreme pressures and temperatures involved, it is felt that design for such an environment presents an engineering problem of the first magnitude. Author

N66-10436# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE PLANET MERCURY: A TWENTY-YEAR SURVEY OF THE LITERATURE
Rosa Bernstein Mar. 1964 30 p refs
(R64SD20)

A bibliography is presented on the planet Mercury and includes 145 references published over the past 20 years, 37 of which have abstracts. This collection was intended as a starting point for a preliminary study to consider sending an unmanned scientific probe to the planet. R.N.A.

N66-10480# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SOME NUMERICAL RESULTS OF GEOCENTRIC LOW THRUST TRAJECTORY OPTIMIZATION
Hans K. Hinz, Robert Mc Gill, and Gerald Taylor Apr. 1965 28 p refs
(RM-270J)

The generalized Newton-Raphson method is used to determine optimum, coplanar, circle-to-circle, transfer trajectories for low thrust space vehicles operating in a strong central force field, such as a near earth orbit. Optimum thrust steering programs are computed for progressively increasing values of final time up to durations involving 26 revolutions about the earth. A description of the numerical results and a comparison of these with the results of a previous linear analysis are given. Author

N66-10482# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SEARCH FOR A LUNAR SURFACE MODEL. VOLUME II: POLARIMETRY
W. G. Egan May 1965 28 p refs
(RM-276)

In this memorandum, it is indicated that the observed polarization of the electromagnetic radiation (in the range from 0.36 to 1 micron) reflected by the lunar surface yields information from which may be inferred the properties of the layer of the material on the moon that interacts with this radiation. Reported are some initial results of polarimetry work. A large scale photometer previously used for photometry was modified to permit precision measurements of per cent polarization and position of the plane of polarization. Supplementing these measurements, a theoretical program has been initiated utilizing a multiple scattering approach based on detailed material properties. Also, a program has been started to provide detailed specification of materials studied, and the experimental apparatus employed. Author

N66-10483# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
RESEARCH ON OPTIMIZATION THEORY AND AEROSPACE APPLICATIONS Final Report, 1 Jan. 1963–31 Mar. 1965
R. E. Kopp May 1965 18 p refs
(Contract AF 49(638)-1207)
(RM-279)

The research conducted is summarized for the following: (1) successive approximation techniques for the solution of optimization problems; (2) parametric studies of air vehicle trajectories; (3) singular extremals; (4) Trefftz–Friedrichs duality principle; and (5) transversal surface theory and necessary conditions. Two numerical techniques for the solution of optimization problems were developed for solution on high speed digital computers. Numerical studies were made of minimum fuel acceleration-climb maneuvers for a representative supersonic transport design. Optimal performance tradeoffs to be expected with various sonic boom overpressure limit constraints are illustrated. These studies present a systematic computational algorithm for practical treatment of a class of complex optimal control problems involving atmospheric flight. The work on singular extremals was concerned with the derivation of general necessary conditions for minimality of singular arcs over short intervals of time. E.E.B.

N66-10494# Boeing Co., Seattle, Wash.
CONTROL MOMENT GYROS IN ATTITUDE CONTROL
Donald J. Liska and Arthur Dean Jacot [1965] 64 p refs
(D2-90759-1; AD-467021)

The problem of controlling attitude of manned space stations suggests use of systems combining Control Moment Gyros (CMG's) and Reaction Control Jets (RCJ's). Several such systems have been investigated. The problem areas uncovered and the techniques generated to solve them are described. For control of spinning vehicles the basic problems investigated were nutation damping and stable spin about nonprincipal axes. Of several CMG configurations studied, some proved ineffective due to GMC coupling with the vehicle spin velocity; others inherently destabilized the system. Techniques for overcoming these problems are discussed. In non-spinning vehicles, the basic requirement is for stabilization accuracy and three problem areas are discussed. The first involves destruction of the CMG's with practical RCJ systems. Techniques such as timed desaturation pulses, gimbal position and rate controlled desaturation, and programmed gimbal torqueing during desaturation are discussed to overcome these difficulties. The results of tests performed on an air-bearing simulator are also discussed. The second problem area results from hardware nonlinearities and noise. Important characteristics are discussed, and computer simulations are compared against actual test data. The third problem area is caused by CMG interaxis coupling torques. As a solution to this problem, a unique two degree of freedom CMG is described which inherently eliminates the undesired coupling torques. Author (TAB)

N66-10523# Martin Co., Baltimore, Md.
ONE WAY INTERPLANETARY TRAJECTORIES. DIGITAL COMPUTER PROGRAM UBO87
Karlis Minka May 1964 99 p refs
(ER-13476)

A method, including the analytical development and a computer program, for the solution of approximate interplanetary trajectories is presented. The solutions are obtained for given departure (Julian) dates, transfer times, pericenter radii and inclinations at departure and arrival planets. They are in the form of position and velocity vectors at significant (including initial) points on the transfer trajectory. In addition, other significant characteristics of the orbits are computed.

The method gives an exact solution for the series of two-body systems. Elliptic, non-coplanar orbits for Earth and planet are assumed in the form of mean Keplerian orbits which are computed from given ephemeris data. The sphere-of-influence method in combination with two-body equations in Cartesian coordinates is used. The program is useful for determining the sensitivities of the trajectory elements. In addition, it can be used for parametric studies and space guidance computation applications. Author

N66-10551# Smithsonian Astrophysical Observatory, Cambridge, Mass.
BRIGHTNESS CHANGES IN PERIODIC COMETS
Fred L. Whipple and Diarmaid H. Douglas-Hamilton 9 Aug. 1965 19 p refs
(SAO Special Rept.-181)

Visual brightness estimates of Comets Encke and Faye are corrected for aperture of telescope by a formula due to Opik, and reduced to absolute magnitude (H). A secular decrease in absolute brightness is indicated for both. On the assumption of a linear decrease with time in the diameter and brightness of an icy nucleus, death dates of 1991–2000 for Encke and 1978–1985 for Faye were found. The possible dependence of absolute magnitude fluctuations on solar activity is examined by plotting residuals from the magnitude curve against the mean monthly sunspot number for Comet Encke. No correlation is found. Author

N66-10558*# National Aeronautics and Space Administration, Washington, D. C.
PROJECT RANGER
[1965] 12 p Updates Vol. II, No. 6 Supersedes NASA Facts-A-62; see N65-25644
(NASA Facts, Vol. III; No. 2; NASA Facts, Vol. II, No. 6; NASA Facts-A-62) GPO: $0.15 CSCL 03A

The achievements and characteristics of the Ranger project are summarized. Telecasts to earth revealed lunar surface features as small as 10 inches across. In contrast, even the most powerful telescopes on earth enable man to discern lunar features no smaller in size than a half mile. Rangers VII, VIII, and IX provided 17 255 close-ups of the moon before crashing on the lunar surface. Photographs of the lunar surface, Ranger spacecraft, Atlas-Agena launch, and equipment are included. Also, data on the nine Ranger launches are given including launch dates, mission, and principle results. E.E.B.

N66-10590# Defence Research Board, Ottawa (Ontario).
DIRECTORATE OF SCIENTIFIC INFORMATION SERVICES. THE LATITUDE BOUNDARIES OF JUPITER'S BANDS
M. V. Stovas Aug. 1965 8 p refs Transl. into ENGLISH from IGY Inform. Bull., IGY Organizing Comm., Presidium of the Acad. of Sci., Ukrain. SSR, (Kiev), no. 3, 1961 p 65–70 (T-439-R) CFSTI: HC $1.00/MF $0.50

The latitudinal bands of Jupiter are discussed as phenomena reflecting, in Jupiter's atmosphere, the particular tektonics of the planet. Physical relationships are established connecting the latitudes of the bands, the active formations, and the critical parallels—a relationship which can only arise in the solid core of the planet through variation of the potential of deforming forces. The author comes to the conclusion that a volcanism is, perhaps, produced by changes in the rotational regime of the planet. Author

N66-10592*# Consultants and Designers, Inc., Arlington, Va.
RADIO EMISSION OF SATURN IN 8 mm WAVELENGTH
V. G. Kutuza, B. Ya. Losovskiy, A. E. Salomonovich 22 Jun. 1965 5 p Transl. into ENGLISH from Astron., Dokl. Acad. Nauk SSSR, v. 161, no. 6, 1965 p 1301–1302
(Contract NAS5-3760)
(NASA-TT-F-9690; ST-RA-LPS-10348) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Radioastronomical investigations of Saturn in the 8 mm wave, conducted in July–August 1964, led to results, agreeing well in regard to brightness temperature with previous results of measurements of Saturn's infrared emission and corroborating the presence in 10 cm wave of increased radio emission which may be evidence of the presence around Saturn of a radiation belt. Author

N66-10607*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF DIRECT AND INDIRECT ASCENT MODES FOR THE 1969 MARS OPPORTUNITY WITH AN ATLAS–CENTAUR LAUNCH VEHICLE
Tim J. Kreiter Washington, NASA, Nov. 1965 21 p refs
(NASA-TM-X-1181) CFSTI: HC $1.00/MF $0.50 CSCL 22C

The payload capabilities of the Atlas–Centaur launch vehicle were evaluated for the 1969 Mars opportunity. In this evaluation, type I (heliocentric travel angle less than 180°) and type II (heliocentric travel angle greater than 180°) Earth-Mars trajectories were studied and both the direct and indirect launching modes were considered. The direct ascent launching mode is characterized by a continuous powered-flight phase, and launch windows are generated by varying injection true anomaly, launch azimuth, and injection velocity. For indirect ascent trajectories, two powered-flight phases exist with a parking-orbit phase separating the two burning periods. Launch windows are developed by varying launch azimuth and the time spent in the parking orbit. Trajectories were selected that maximized launch-vehicle performance. Launch azimuth was restricted to less than or equal to 114°, and a minimum daily launch window of 60 minutes was imposed. Author

N66-10609*# Stanford Univ., California. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semiannual Report No. 5, 1 Jan.–30 Jun. 1965
V. R. Eshleman Jul. 1965 11 p refs
(Grant NsG-377)
(NASA-CR-67794) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Radar astronomy research is presented on cislunar gas studies, planetary atmospheres and ionospheres, detection of interplanetary shock waves, solar radar studies, and polarization of decametric radiation from Jupiter. R.N.A.

N66-10610*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
ASCENT AND DESCENT ABORT FLIGHT CORRIDORS FOR ORBITAL TRANSPORT VEHICLES
J. L. Diven and J. W. Daniel Mar. 1965 194 p refs
(Contract NAS8-5289)
(NASA-CR-67789; R-142) CFSTI: HC $5.00/MF $1.25 CSCL 22D

The two dimensional equations of motion for a point mass vehicle are derived in the circular earth coordinate system. The two coordinates utilized are the total velocity vector and the flight path angle referenced to the local horizon. Equations for the load factor and equilibrium stagnation temperature on a flight vehicle are derived. The solution of these equations

to obtain temperature limited and load factor limited abort flight corridors is discussed in detail. A Fortran IV computer program was written to solve the equations of motion and flight path equations to obtain the abort flight corridors. Author

N66-10649*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
CATALOG OF PRECISELY REDUCED OBSERVATIONS, NO. P-14
3 Sep. 1965 128 p refs
(Grant NsG-87-60)
(NASA-CR-67847; SAO Special Rept.-185) CFSTI: HC $4.00/MF $1.00 CSCL 03A

Presented are 545 observations of various satellites. The observations (position and time) were reduced and all the measurements were made with two-screw Mann comparators. The time accuracy of the observations depends primarily on the stability of the station clock and on the reception of the time signals. Uncertainties were estimated according to these criteria varying from ±0.5 msec to ±20 msec, with an average value of ±2 msec. In order to expedite processing of the observations, it was necessary to employ a smoothed preliminary A.1 time system in the reductions. R.W.H.

N66-10662*# Space Technology Labs., Inc., Redondo Beach, Calif.
CAPABILITY GUIDE: TRACKING ACCURACY PREDICTION PROGRAM (TAPP MOD I)
A. S. Liu Nov. 1962 150 p refs Revised Prepared for JPL (Contracts NAS7-100; JPL-950045)
(STL-8976-6013-RU-000, Rev.) CFSTI: HC $4.00/MF $1.00 CSCL 22C

A functional block diagram is presented of the Tracking Accuracy Prediction Program designed specifically for the statistical analysis of preflight orbit determination problems, and includes a general description of each major program block. Also included is a series of appendices which describe the input requirements, output options, and print formats; and give all equations used in the various program blocks. R.N.A.

N66-10685*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
TABLES FOR CALCULATING THE VOIGT PROFILE
Charles Young Jul. 1965 126 p refs *Its* Rept.-05863-7-T (Contract NASr-54(03)) CFSTI: HC $4.00/MF $1.00 CSCL 03B

The tables present K(x,y) for the range x = 0 to 240, and y = 0 to 23, and were specifically prepared for meteorological radiative transfer calculations. Computation details are given, and methods for using the tables are suggested. M.G.J.

N66-10703*# Northrop Space Labs., Huntsville, Ala.
LUNAR DUST/DEBRIS HAZARDS ASSOCIATED WITH THE MANNED FLYING SYSTEM
R. L. Stark, F. B. Tatom, L. M. Bhalla, and H. W. Hsu Huntsville, Ala., NASA. Marshall Space Flight Center, Oct. 1965 34 p refs (Contract NAS8-20082)
(NASA-CR-61106) CFSTI: HC $2.00/MF $0.50 CSCL 22A

The results are presented of a preliminary investigation to determine the nature of potential hazards associated with the impingement of the exhaust gases of the Manned Flying System (MFS) on a dust- and/or debris-covered lunar surface. An engineering model is established based on the results of preceding investigations. The behavior of individual particles of dust, set in motion by jet impingement, is predicted. The results indicate that there is a possibility of dust/debris directly striking the MFS only at very low altitudes (less than six feet) with impingement craters of small radii (less than 4.5 feet). The distance out to which particles are thrown is considerable, however, ranging as high as 1200 miles, and the possibility does exist that particles may strike personnel or equipment on the lunar surface in the vicinity of the landing site of the MFS. The possibility also exists that, during the descent or ascent of the MFS in the proximity of sheer, vertical surfaces, projected particles may ricochet off such surfaces and then strike the MFS. Author

N66-10710 Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.
ESTIMATES OF LUNAR LUMINESCENCE AND THEIR BEARING ON LUNAR SURFACE COMPOSITION
N. N. Greenman Sep. 1963 50 p refs
(SM-42832)

Some estimates are made of lunar intensity that might be expected from various models of lunar surface composition, and an attempt is made to estimate the lithologic composition of the lunar surface from the luminescence data. Three of the models used assume that the contribution of meteoritic infall to the lunar surface is negligible; three variations of a fourth model assume that the lunar surface has the composition of the average meteorite. Some tentative estimates are made of the relative luminescent intensities of the rocks making up the four models; minerals considered in estimating lunar luminescence are amphibole, feldspar, mica, olivine, pyroxene, and quartz. Results are compared with those obtained by Dubois in order to estimate possible surface compositions. M.W.R.

N66-10749*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MONTE CARLO APPROACH TO TOUCHDOWN DYNAMICS FOR SOFT LUNAR LANDINGS
Robert E. Lavender Washington, NASA, Nov. 1965 57 p refs
(NASA-TN-D-3117) CFSTI: HC $3.00/MF $0.50 CSCL 22A

Results of analytical touchdown dynamics investigations are presented which were conducted to obtain estimates of the probability of stable landing for configurations with various landing gear diameters. Both three-legged and four-legged vehicles are considered in the analysis. Dynamic scaling considerations are taken into account so that the results are applicable to a wide range of vehicle size and mass. A Monte Carlo approach is taken in the determination of initial landing conditions. Results indicate that for a given probability of stable landing, a three-legged vehicle requires a landing gear diameter only slightly larger than the diameter required for a four-legged vehicle. Therefore the three-legged vehicle's landing gear should weigh less. Author

N66-10750*# National Aeronautics and Space Administration, Washington, D. C.
SPACE AND THE INTERNATIONAL COOPERATION YEAR—A NATIONAL CHALLENGE
Arnold W. Frutkin [1965] 21 p
(NASA-EP-30) GPO: HC $0.20; CFSTI: MF $0.50 CSCL 22A

The principal areas of international cooperation on space research are surveyed by Arnold Frutkin, Assistant Administrator for International Affairs, NASA. The informal cooperation of the scientific community and the role of such nongovernmental groups, as the International Committee for Space Research (COSPAR), in reflecting the opinion of space scientists

throughout the world are emphasized. Development of NASA's cooperative space program is traced, with details given on the international satellites in orbit; sounding rocket projects; ground-based installations; observations by foreign weather bureaus; personnel exchanges; and training programs. Space cooperation with the Soviet Union is discussed, with details given on the bilateral space agreement of 1962. Also discussed are the programs undertaken by the European Space Research Organization (ESRO), the European Launcher Development Organization (ELDO), and the United Nations. It is pointed out that the challenge faced by the United States during International Cooperation Year is to keep the hope and promise of cooperation alive. M.G.J.

N66-10800# Hamburger Sternwarte (West Germany).
SPECTROPHOTOMETRY OF GALACTIC NEBULAE: ORION NEBULA III Final Scientific Report
K. Wurm 30 Nov. 1964 58 p refs
(Contract AF 61(052)-259)
(AFCRL-65-165; AD-620117)

The internal physical structure of the Orion Nebula has been investigated. A realistic model of the nebula has been developed, which deviates strongly from a symmetrically spherical model. The Trapezium stars are situated on one side of the radiating masses of the center, on the side to the observer. Author (TAB)

N66-10801*# Space Technology Labs., Inc., Redondo Beach, Calif.
STUDY OF AN ABLE-MARS ENCOUNTER MISSION
31 Aug. 1962 101 p
(Contract NASw-246)
(NASA-CR-67778) CFSTI: HC $4.00/MF $0.75 CSCL 22C

The primary object of the study was to estimate the accuracy requirements and to determine the capability of the spin stabilized Able-M spacecraft for achieving the required accuracy. Trajectories, midcourse guidance, and the physical constants which affect accuracy are considered in detail. In addition, the required modifications to the spacecraft were examined; a spacecraft communications system was designed; and the problem of determining the distance by which the spacecraft misses Mars was examined. The constraints placed upon the system are discussed. E.E.B.

N66-10867# Illinois Univ., Urbana. Coordinated Science Lab.
[SPACE SCIENCE, NUCLEAR AND PLASMA PHYSICS, COMPUTER PROGRAMMING, AND COMMUNICATIONS RESEARCH] Progress Report, Mar.–May 1965
26 Jul. 1965 105 p refs
(AD-619504)

Progress is reported in the following fields: ionospheric data, surface and atomic physics, computer applications, computer systems, PLATO, plasma physics, superconductors, high voltage breakdown, thin films, switching systems, communication theory, circuity. TAB

N66-10880*# National Aeronautics and Space Administration, Washington, D. C.
THE NATION'S MANNED SPACE FLIGHTS
Hugh L. Dryden [1965] 19 p Presented at the Governor's Conf. on Oceanog. and Astronautics, Kauai, Hawaii, 1 Oct. 1965
(NASA-TM-X-56879) CFSTI: HC $1.00/MF $0.50 CSCL 22A

The achievement of our space goals requires hard work, resourcefulness, and daring, according to Dr. Hugh L. Dryden, Deputy Administrator, NASA. It requires the skills and abilities of scientists, engineers, educators, industrialists, artisans, and craftsmen all over the nation; and it also requires the determination of the American people. It is the aim of NASA to marshal a nationwide team of the most competent participants working toward a common goal in order to strengthen our free institutions in industry, universities, government, and local communities. Dr. Dryden points out that we are accumulating, in space, the basic scientific knowledge about the earth, the solar system, the universe, and about man himself. Benefits reaped are brought to the entire world through the use of space and space technology, employing such new tools as weather, communications, and navigational satellites; and space-based techniques, equipment, and materials are applied to improve industrial products, processes, and services. In addition, a much-needed stimulus is being provided to the energies and creativity of people everywhere particularly to the minds and aspirations of young people. Further, increased economic activity is being brought about at a time when the effects of automation on our society are beginning to be felt. R.R.D.

N66-10887*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STUDY OF MARS AND VENUS ORBITER MISSIONS LAUNCHED BY THE 3-STAGE SATURN C-1B VEHICLE, VOLUME III
W. E. Arens et al 31 Dec. 1963 522 p refs
(Contract NAS7-100)
(NASA-CR-67606; EPD-139, Vol. III) CFSTI: HC $8.00/MF $2.50 CSCL 22A

A combination orbiter/landing-capsule mission for the 1969 Mars opportunity has been considered in terms of possible conceptual spacecraft system designs, corresponding mission capabilities, and the associated problem areas. A range of orbiter and lander capabilities has been examined which is consistent with the injection capability of the Saturn I-B/SV vehicle. The missions and systems considered have been found to be scientifically significant, technologically achievable, and potentially attractive as candidates for inclusion in the NASA planetary exploration program, and hence may be worthy of a complete design study effort. Author

N66-10916# California Univ., Los Angeles. Dept. of Engineering.
THE OPTIMIZATION OF AEROSPACE RE-ENTRY VEHICLE TRAJECTORIES THROUGH INDEPENDENT CONTROL OF LIFT AND DRAG Final Report, May 1964–May 1965
Cornelius T. Leondes and Robert A. Niemann Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Aug. 1965 49 p refs *Its* Rept.-65-8, Pt. II
(Contract AF 33(615)-1794)
(AFFDL-TR-65-78; AD-471690)

Equations of motion are written for a lifting manned space vehicle reentering the atmosphere with means for independent control of lift and drag coefficients. A performance criterion is given as a weighted function of vehicle heating and deceleration experienced by the astronauts. Pontryagin's maximum principle is applied to optimize this performance criterion for the vehicle re-entering at orbital velocity and for no constraints on the terminal end of the trajectory. An iterative technique employing sensitivity functions is derived for solving the two-point boundary value problem. There are many parameters whose effect on the vehicle optimization problem must be studied, including the initial flight path angle, the time of the

trajectory, and relative weighting of the deceleration with respect to the heat rate in the criterion function. The computational problems associated with obtaining the optimization results for a problem of this complexity are considered. The results for optimized trajectories are studied and some rather general conclusions are drawn. It is shown that the lift and drag required by this method of vehicle optimization are physically realizable. Author (TAB)

N66-10945# RAND Corp., Santa Monica, Calif.
AN APPROXIMATE SOLUTION TO THE RELATIVE MOTION OF TWO CLOSE SATELLITES IN THE PRESENCE OF DRAG AND OBLATENESS
H. B. Schechter and J. D. Cole Aug. 1965 61 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4481-PR; AD-620834)

This memorandum is concerned with the relative motion of two satellites under the influence of air drag and the J term in the earth's potential. An exponential atmosphere is assumed, and a linear fit is shown to be satisfactory for changes in altitude of up to about 40 percent of the scale height. The motion is referred to a coordinate system attached to an infinitely heavy satellite moving along a circular orbit at an altitude of 100 n mi. The first-order effects of drag and oblateness are obtained, using a two-time variable-expansion procedure proposed by Kevorkian (the two variable expansion procedures for the approximate solution of certain non-linear differential equations, Douglas Aircraft Co., Douglas report SM-42620, Dec. 3, 1962). The two satellites are assumed to start out from the same point on the circular orbit, but with a tangential velocity difference of not more than about 10 ft/sec. Simple algebraic expressions are obtained which provide a quick and fairly accurate way to determine the separation distance at the end of n orbits.
Author (TAB)

N66-10953 Royal Greenwich Observatory, Herstmonceux (England).
INVESTIGATION OF PROPER MOTIONS IN THE FIELD OF THE CLUSTER M 67. PART I: THE CENTRAL REGION
C. A. Murray, P. M. Corben, and Mary R. Allchorn London, HMSO, 1965 38 p refs *Its* Bull. No. 91 HMSO: 5s 6d

Proper motions of nearly 500 stars in the field of the cluster M67, derived from plate-pairs taken with the Thompson 26-inch refractor, and with a 60-inch reflector, are discussed. The survey is virtually complete to $B = 16^m5$ in an area $27' \times 27'$ near the cluster center. The blue upper main-sequence stars, and a number of bright stars of intermediate color are confirmed cluster members on the basis of their proper motions and positions on the plate. The total number of non-members, and their distribution in apparent magnitude, are in excellent agreement with van Rhijn's tables. Distances of field stars in the color range $0^m5 \leq B-V < 0^m8$ have been computed on the assumption that they are main-sequence dwarfs, and their velocity ellipse is in good agreement with that for the G dwarfs in the solar neighborhood. By means of these stars, the proper motion of the cluster relative to the Oort motion is derived, and its peculiar space motion is determined using Popper's observed radial velocity and the standard solar motion.
Author

N66-10954# Royal Greenwich Observatory, Herstmonceux (England).
MEASUREMENTS OF RADIAL VELOCITY FROM COUDE PLATES
Richard Woolley and G. A. Harding London, HMSO, 1965 19 p refs *Its* Bull. No. 93 HMSO: 3s

The spectrum of 96 stars taken with the coudé spectrograph have been measured for radial velocity, the dispersions being between 4.3 and 15.6 A/mm. Measurement was by direct observation of the shift between corresponding star and comparison-arc lines, without reference to accurate wavelengths. In addition, thirty-five spectra of the Moon were taken on the various spectrographs and measured to examine the zero of the system. For the thirty-five observations a mean residual of +0.1 km/s ±0.1 s.e. was found. Velocities for individual components of twelve double stars are included giving a mean (A components −B component) of +0.5 km/s ±0.4 s.e. Further observations of five variables in the Hyades cluster are listed, together with eight observations of four other stars in van Bueren's list, for determination of membership. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N66-10061 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ADVANCED DESIGN CONCEPTS FOR A REMOTELY OPERATED MANIPULATOR SYSTEM FOR SPACE-SUPPORT OPERATIONS
Charles E. Vivian, W. H. Wilkins, and L. L. Haas *In* AEC Remotely Operated Special Equipment [1964] p 248–303 (See N66-10051 01-15) CFSTI: $4.00

A remotely operated handling system referred to as SCHMOO (Space Cargo Handler and Manipulator for Orbital Operations) is described. This system is an unmanned space module designed to be dispatched from a space station to perform various operations such as stage refueling, docking, detachment and attachment of nuclear and chemical engines from a stage, and disassembly and reassembly of electronic modules. The module is controlled by operators located in the space station. A comprehensive, descriptive design of the SCHMOO vehicle and it's components is presented and includes definitions of the physical configuration of the vehicle, manipulator arms, and attachment arms; propulsion and attitude control systems; guidance and manipulator-control equipment, including telemetering; and the power systems necessary to operate SCHMOO successfully in a variety of missions. M.R.W.

N66-10226*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELAY I PROGRAM Final Report
Washington, NASA, 1965 749 p refs
(NASA-SP-76) GPO: HC $4.25; CFSTI: MF $3.50 CSCL 22B

Relay I program papers are presented on the overall Relay system, operational problems, and international ground stations. For individual titles see N66-10227–N66-10261.

N66-10227* Space Technology Labs., Inc., Redondo Beach, Calif.
THE RELAY SYSTEM
B. N. Abramson, W. Littenberg, M. R. Skinner, and C. M. Thomas *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 5–19 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1302)

System design tradeoffs, spacecraft specifications, and orbit characteristics are summarized for the Relay I program. Ground and test station design characteristics are considered in terms of frequency selection and necessary power levels; communication system characteristics and performance objectives are discussed; and communication link performance margins between the various stations are evaluated. Power budgets for transmission of television and telephony between two stations are tabulated, and system performance for these transmissions is listed. A map shows the location of the seven ground and test stations are tabulated. The antenna and receiver are described for each, along with transmitting and receiving capabilities, gain at 1725 and 4170 Me, and total system noise temperature at 7.5° elevation. M.W.R.

N66-10228* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE RELAY SPACECRAFT

P. H. Pickard *In its* Relay I Program 1965 p 21–27 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

Structure, power, communications, telemetry, tracking, and command are discussed for the Relay I spacecraft; a cutaway drawing shows the positions of the various components. Two completely independent microwave repeaters, with a common antenna, are provided to increase spacecraft reliability. The satellite transmitter output power of 10 watts gives a margin of at least 6db for TV transmission over a maximum slant range of 5000 nautical miles. The receiver is completely solid state; the microwave antenna consists of a coaxial receiving antenna above a coaxial transmitting antenna, both contained in one mechanical assembly. Both wideband and narrowband modes of operation can be used with the transponder. In addition to the subsystems required to support the principal mission of Relay, the spacecraft contains six radiation detectors and a number of isolated solar cells and semiconductor diodes to obtain data on particle radiation in space. M.W.R.

N66-10230* Space Technology Labs., Inc., Redondo Beach, Calif.

SPACECRAFT PERFORMANCE

D. E. Kendall *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 63–90 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50

(Contract NAS5-1302)

Observed performance of the Relay I spacecraft is detailed and compared with prelaunch and expected results; and spacecraft temperature history, orientation, and spin rate characteristics are discussed. Electrical power system performance data deal with transponder no. 1 failure, load verification, and solar array performance. With the exception of the failure of the no. 2 charge controller, adequate battery performance was observed. Numerous graphs detail aspects of battery performance, including improvement after low voltage cutoff, discharge curves before and after continuous trickle mode, characteristics before and after deep discharge, and accumulated transponder no. 2 operating time compared with eclipse history. Electrical performance specifications are tabulated, and wideband receiver and transmitter block diagrams are included. Data for the traveling wave tube indicate that TWT characteristics remained essentially constant during the operational lifetime of Relay I. M.W.R.

N66-10412*# National Aeronautics and Space Administration, Washington, D. C.

FLIGHT OF THE "VOSKHOD-2" [POLET KOSMICHESKOGO KORABLYA "VOSKHOD-2"]

P. I. Belyayev Oct. 1965 11 p Transl. into ENGLISH of paper presented at the 16th Intern. Astronautics Congr., Athens, 13–18 Sep. 1965

(NASA-TT-F-9728) CFSTI: HC $1.00/MF $0.50 CSCL 22B

A personal account of the flight of the Voskhod-2 spacecraft and of the walk in space conducted by his co-pilot is presented. In addition to describing the airlock method of egress into space, the scientific experiments conducted during the flight, the manual control landing, and the instrumentation are discussed. L.S.

N66-10427*# National Aeronautics and Space Administration, Washington, D. C.

METEOROLOGICAL SATELLITES AND SOUNDING ROCKETS

[1965] 25 p

(NASA-EP-27) GPO: HC $0.20; CFSTI: MF $0.50 CSCL 22B

NASA's meteorological program is examined in terms of the TIROS and Nimbus meteorological satellites, meteorological sounding rockets, and new and improved measuring and sensing instruments for use on these satellites and sounding rockets. General descriptions are presented on the development, instrumentation, operation, and accomplishments of TIROS I through VIII which are compared to those of Nimbus. Meteorological data acquisition by the automatic picture transmission system, the vidicon camera system, and the high resolution infrared radiometer used on Nimbus is discussed; and future Nimbus components are described. Discussions are included on the development of small meteorological sounding rockets and large meteorological sounding rocket experiments. The synchronous meteorological satellite, the development of a day-night vidicon, and the calibration of infrared sensors are also described. R.N.A.

N66-10473# Martin Co., Baltimore, Md. Nuclear Div.

NIMBUS DYNAMICS ANALYSIS FOR EJECTION MECHANISM

R. G. Burgio and M. C. Miller Jun. 1965 34 p ref

(Contract AT(30-1)-2345)

(MND-3169-68)

Ejection of the SNAP 19 generator from the NIMBUS-B satellite has been studied theoretically using a modified 3 degree-of-freedom (pitch plane) trajectory computer program. Effects of initial altitude and satellite attitude have been included. Nearly every case investigated showed that interference would exist between the generator and NIMBUS stabilization and control sub system immediately following ejection. Interference was reduced by approximately 50% when the following stabilization and control sub system protuberances were removed from the ejection path of the generator: sun shield horizon scanner, baffle–coarse yaw sensor, and albedo shield coarse yaw sensor. In the cases where there was no interference between the generator and NIMBUS, the generator was ejected well beyond the satellite. Author

N66-10612*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

ELECTRICALLY-PROPELLED CARGO VEHICLE FOR SUSTAINED LUNAR SUPPLY OPERATIONS Final Report

J. W. Larson et al 28 Jun. 1965 235 p refs

(Contract NAS8-11207)

(NASA-CR-67807; GE-65SD4361) CFSTI: HC $6.00/MF $1.25 CSCL 22B

A study was conducted to determine the applicability and the optimum operating modes of electrically propelled earth-moon shuttle vehicles for logistic support of advanced lunar operations. Major design choices are presented, the

consequences of various selections are defined, and a rational base for system optimization is provided. A generalized analysis of the sustained lunar supply problem was developed based on the use of a reusable power limited vehicle or propulsion module. Lunar logistic mission requirements were examined to determine the performance requirement for the electrically propelled vehicle to be competitive with other transportation systems. The physical constraint of trajectory and propulsion requirement and the state-of-the-art constraints for definition of the spacecraft were investigated. Three parallel computer programs were required to generate the final parametric performance data to accommodate single trip versus multiple trip, and single powerplant versus multiple powerplant modes. Details of the lunar supply system for off-optimum selections, and technical approach for a more refined cost optimization approach for use when more technical information is available on power system development are described in the appendices. R.N.A.

N66-10617*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VOYAGER PROJECT Progress Report, 16 Aug.–15 Sep. 1965
1 Oct. 1965 35 p
(Contract NAS7-100)
(NASA-CR-67869; VPPR-8) CFSTI: HC $2.00/MF $0.50 CSCL 22A

The current status of the Voyager project is summarized and progress is described on current activities in project scheduling, mission engineering, data and configuration magagement, facilities, fabrication, and quality assurance; and spacecraft and capsule scheduling, reliability, testing, system design, instrumentation, propulsion, and telecommunications. R.N.A.

N66-10631*# Little (Arthur D.), Inc., Cambridge, Mass.
THERMAL SCALE MODELING OF THE MARINER IV SPACECRAFT Final Report
Frank Gabron and Robert W. Johnson 20 Aug. 1965 173 p
Prepared for JPL
(Contracts NAS7-100; JPL-950789)
(NASA-CR-67762) CFSTI: HC $5.00/MF $1.00 CSCL 22B

Research conducted under a program designed to determine the feasibility of predicting equilibrium temperatures in a complex flight spacecraft from environmental simulation tests of a small-scale thermal model, is reported. The basis for determining the feasibility of the technique was a comparison of scale model temperatures, measured in solar simulation tests, with temperature data obtained during the recent Mariner-IV flight to Mars. Results indicated that thermal scale modeling techniques can be successfully applied to the prediction of flight temperatures of a complex spacecraft. Temperature predictions made from measurements with a small-scale thermal model in an environmental chamber were sufficiently accurate to presently warrant the use of these techniques in preliminary design and development of large, complex spacecraft. Data on the accuracy of temperature predictions made for the Mariner-IV spacecraft are summarized. Comparisons are based on measurements at twenty homologous locations in the model and Mariner-IV. The basis for the comparison was temperature data telemetered to Earth from the Mariner-IV spacecraft. S.C.W.

N66-10639*# Control Research Associates, College Park, Md.
ADVANCE RESEARCH ON CONTROL SYSTEMS FOR THE SATURN LAUNCH VEHICLE Final Report, Jan., 1964–May, 1965
D. C. Lewis and P. Mendelson 31 May 1965 214 p
(Contract NAS8-11143)
(NASA-CR-67628) CFSTI: HC $6.00/MF $1.25 CSCL 22B

Presented are the results of studies on a minimax problem in launch vehicle control. This is the general problem of finding a control which minimizes the maximum peak value of a selected index of performance over a class of admissable disturbances while satisfying a bounded state variable constraint. Some rigorous mathematical foundations are established for the minimax problem. These include a precise formulation of the problem and existence theorems for solution of the problem. In connection with the bounded state variable problem, a new concept called the core of the region of bounded state variables is introduced. This is roughly defined as the largest set of initial conditions for which solution trajectories remain inside the bounded set of state variables under any admissible disturbance. Existence and uniqueness of the core of a region are discussed, and for some sample second and third order problems, the core is computed. Author

N66-10640*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR PROJECT STATUS REPORT, 13 NOVEMBER 1964
L. S. Frankenstein 13 Nov. 1964 19 p
(Contract NAS7-100)
(NASA-CR-67638; SPSR-64) CFSTI: HC $1.00/MF $0.50 CSCL 22B

A demonstration of a soft landing on the moon as evidenced by postlanding spacecraft operations in one or more missions is under investigation. These missions will utilize the Atlas/Centaur launch vehicle with launches to be conducted from Complex 36. Direct ascent launch trajectories with a spacecraft having a nominal separated weight of 2150 lbs will be utilized. The missions will be divided into two groups consisting of four spacecraft designated as engineering flight tests and containing an engineering performance payload, and three spacecraft designated as operational vehicles which contain a scientific instrument payload. Status of various system tests is also discussed. R.W.H.

N66-10641*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR PROJECT STATUS REPORT, 27 NOVEMEBER, 1964
L. S. Frankenstein 27 Nov. [1964] 21 p
(Contract NAS7-100)
(NASA-CR-67640; SPSR-65) CFSTI: HC $1.00/MF $0.50 CSCL 22B

The T-21 spacecraft continues to undergo checkout prior to the start of thermal vacuum testing. The TV telecommunication tests were completed. The flight control sensor group which was out for repair was returned and retesting was started. The T-21 system functional test phase will continue, with the flight control group test and the flight control/AMR/RADVS integration tests planned. Upon completion of these tests, the vehicle will enter the solar thermal-vacuum test phase. R.W.H.

N66-10642*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR PROJECT STATUS REPORT, 8 JANUARY, 1965
L. S. Frankenstein [1965] 21 p
(Contract NAS7-100)
(NASA-CR-67641) CFSTI: HC $1.00/MF $0.50 CSCL 22B

The upgrade program preparatory to the start of the solar vacuum testing was completed. Final preparations for solar vacuum testing is underway. The retro motor was installed, the vernier propulsion system was filled with referee fluids, and the solar vacuum chamber was calibrated. The upgrade of SC-1 was completed, and the vehicle underwent weight, balance and alignment verification tests. R.W.H.

N66-10643*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR PROJECT STATUS REPORT, 5 FEBRUARY, 1965
L. S. Frankenstein 17 Feb. 1965 23 p
(Contract NAS7-100)
(NASA-CR-67639; SPSR-69) CFSTI: HC $1.00/MF $0.50 CSCL 22B

The variable frequency vibration tests were performed (with the planar antenna at 87°) on the S-2A structural test vehicle to evaluate the response of the flight control sensor group. Work continues on checking the orthogonality of the vibration model survey test data. The first group of data indicated acceptable orthogonality properties. R.N.A.

N66-10644*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR PROJECT STATUS REPORT, 19 FEBRUARY 1965
L. S. Frankenstein 25 Feb. 1965 22 p
(Contract NAS7-100)
(NASA-CR-67642; SPSR-70) CFSTI: HC $1.00/MF $0.50 CSCL 22B

System group tests were performed on the SC-2 flight spacecraft. Flight control tests on spacecraft power, and telecommunication intergroup tests were completed. No functional problems were encountered during the tests. The vibration response testing of the flight control sensor group was completed. Static load tests and low level dummy drops were also completed on the vehicle support system. R.W.H.

N66-10704*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
SATURN IB IMPROVEMENT STUDIES (PHASE I) Executive Summary Report
C. R. Zimmerman and M. A. Page 26 Aug. 1965 27 p
(NASA-TM-X-53323) CFSTI: HC $2.00/MF $0.50 CSCL 22D

This report summarizes the results of two studies to investigate modifications to the Saturn IB launch vehicle that would provide increase payload capability for post-Apollo Missions. The modifications include uprated liquid rocket engines, increased propellant capacity, and/or substitute propellants in the S-IB stage; solid propellant rocket boost assist for the S-IB stage; substitution of a large solid propellant rocket for the liquid propellant S-IB stage; application of an S-IVB stage with advanced propulsion in combination with the basic or uprated S-IB stage; and the application of a cryogenic third stage to the basic and uprated Saturn IB vehicles. The report outlines the scope and objectives of the studies, presents the authors' conclusions based on the resulting data, and gives recommendations for future work. Author

N66-10711# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
PROJECT POSSUM: POLAR ORBITING SATELLITE SYSTEM, APPENDIX
23 Jun. 1965 60 p refs

This appendix contains various forms of additional technical information on project POSSUM. Included are the equations of motion of the Scout launch vehicle, a digital printout of the flight variables during accent, and the specific calculations and analysis showing how the power requirements and the size of the solar cell array was determined. The structural weight of the satellite is computed in detail and a more detailed description of the gravity gradient stabilization system is presented. Additional equipment cost figures are given. A preliminary feasibility study is made on the prospects of using the Keweenaw research range as a possible launch area. R.N.A.

N66-10713*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
RESEARCH ON SPACECRAFT AND POWERPLANT INTEGRATION PROBLEMS Spacecraft Analysis Topical Report
J. W. Larson [1964] 193 p *Its* Rept.-64SD892
(Contract NAS3-2533)
(NASA-CR-54159) CFSTI: HC $5.00/MF $1.25 CSCL 22B

Spacecraft and power generating system designs were studied to determine the component and subsystem requirements and further develop areas needed to provide a capability for unmanned scientific exploration of the solar system. Power generation systems included both nuclear Rankine cycle and nuclear in-core thermionic powerplants. Mission requirements were established for unmanned missions marginal for, or beyond the capability of, chemical and solid core nuclear rocket propelled space vehicles. These missions included close approach solar probes, high inclination out-of-ecliptic probes, and orbiters for Mercury and the outer planets beyond Mars. Sample spacecraft and powerplant designs were prepared. Direct comparisons between different powerplant types was difficult because many key components are not advanced enough in development. Rigorous system optimization was not conducted but key problem areas were identified that would likely escape a purely parametric analysis. Detailed component specifications could not be established. R.N.A.

N66-10739# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
PROJECT POSSUM: POLAR ORBITING SATELLITE SYSTEM—UNIVERSITY OF MICHIGAN
23 Jun. 1965 126 p

An engineering proposal for a relatively low cost meteorological weather satellite is presented. Project POSSUM (Polar Orbiting Satellite System—University of Michigan) is designed to provide weather data over the entire region in the vicinity of the poles, namely the polar cap above 55.5° N latitude, and the polar cap below 55.5° S latitude. A Scout vehicle is to be used to launch POSSUM into a circular sun-synchronous orbit; payload weight will be approximately 234 pounds. An orbital analysis is included, and details are given on the subsystems; communications, data processing, and booster systems; launch facilities; and estimated costs. M.G.J.

N66-10743# Congress. House. Committee on Science and Astronautics. Subcommittee on NASA Oversight.
PROJECT SURVEYOR
Washington, GPO, 1965 38 p Report of the 89th Congr., 1st Sess.

This project is considered to be in support of the Apollo project. Surveyor is viewed as complementary to Apollo in that it may assist in site selection for the astronauts, and explore places on the moon where a manned landing may not be feasible or practicable. It was decided that Surveyor is extremely important to the success of the Manner Lunar Landing Project. The investigation of this project has revealed a troublesome history, and showed that all problems are not satisfactorily solved. R.W.H.

N66-10933# Congress. Senate. Committee on Science and Astronautics. Subcommittee on NASA Oversight.
PACING SYSTEMS OF THE APOLLO PROGRAM Staff Study
Washington, GPO, 1965 290 p 89th Congr., 1st Sess.

A status report on the Apollo program which focuses on those items which currently control progress in achieving a lunar landing in this decade, is presented. The primary objectives of the study concentrated on the identification of those major items in the Saturn V launch vehicle program which are the schedule controlling or pacing items, and the identification of the effort being expended to assess whether these items will meet the time scale required for the lunar landing. It is concluded that: (1) the general progress of the Apollo program is good with a reasonable expectation of a lunar landing in this decade; (2) there appear to be no fundamental technological problems to prevent accomplishment of the Apollo goal; (3) NASA possesses both the personnel and management techniques to identify, schedule, and control, satisfactorily the progress in this program; and (4) the lunar excursion module and its associate ground test equipment, and the command and service module and its associate ground test equipment, are the controlling or pacing items in achieving a lunar landing in this decade. A corollary finding of this study indicated that limited additional funds of $200 million over the amount NASA requested in fiscal year 1966 would have provided to NASA increased program alternatives providing additional assurance that a lunar landing will be accomplished in this decade.
S.C.W.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N66-10068# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
REALIZATION AND ANALYSIS OF IMPACT TESTS ON AIRCRAFT STRUCTURES AND ENGINES ON THE GROUND AND IN FLIGHT [REALISATION ET ANALYSE D'ESSAIS IMPULSIONNELS AU SOL ET EN VOL SUR STRUCTURES D'AVIONS ET D'ENGINS]
Gérard Piazzoli [1965] 32 p Presented at the Symp. on Vibrations, Intern. Union of Theoret. and Appl. Mech., Paris, 12–15 Apr. 1965
(ONERA-TP-230) CFSTI: HC $2.00/MF $0.50

The effect of impact upon aircraft and aircraft engine structure during flight and ground testing is considered. The study of aircraft structure performance includes a discussion of the propagation of elastic waves within the structure, circulation effects, and several problems encountered in impact analysis. In the case of the aircraft engine, the effect of shock impact at various stages of operation was recorded by a magnetic device, and results are analyzed briefly. Test data are presented in diagrams and graphs.
Transl. by G.A.L.

N66-10229* Radio Corp. of America, Princeton, N. J.
STRUCTURAL AND DYNAMIC CONSIDERATIONS IN THE SPACECRAFT DESIGN
C. C. Osgood and G. D. Gordon *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 29–62 refs (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1272)

Configuration specifications, load analysis, structural design, and weight considerations are detailed for the Relay I spacecraft. A plot of inertia ratio versus solar cell area was made to determine the limiting values for the necessary design parameters; and allowable dynamic unbalance for various configurations was determined. A counter torquing system was designed to overcome the errors which result from magnetic torques; counter torque produced by current flow through the coil adjusts the spin axis attitude approximately one degree each day. Spacecraft attitude is determined by a solar aspect indicator and an Earth horizon scanner; the angular information obtained is used to calculate the amount and direction of correctional torque and to program the proper commands. Since this method of attitude control requires the residual magnetic dipole moment in the spacecraft to be zero, a compensating magnet is introduced. Requirements for structural materials, methods of fabrication, and coulomb damper design are considered. Basic spacecraft thermal design and the various spacecraft components are described.
M.W.R.

N66-10237* Radio Corp. of America, Princeton, N. J.
SYSTEMS INTEGRATION
W. Schreiner, R. Newman, and M. Gittler *In* NASA. Goddard Space Flight Center Relay I Program 1965 p 227–259 (See N66-10226 01-31) GPO: HC $4.25; CFSTI: MF $3.50
(Contract NAS5-1272)

Qualifications testing of the basic design (using the prototype spacecraft) and acceptance testing of workmanship (using the flight model) are described in the systems integration effort for the Relay I spacecraft. A repeated trial weight method of determining spacecraft balance was employed, and equations were set for determining complete static an dynamic balance of the spacecraft. Analyses indicate that the maximum static unbalance is 0.0045 inch C.G. displacement; maximum dynamic unbalance is 0.0044 radians. Electrical performance and simulated environmental tests are described, and a table gives a listing of all the electrical test equipment used. Power supply; telemetry, tracking, and command; wideband communications; attitude control; and radiation tests were made with the ground test fixture. Shorting plugs were employed to test the spacecraft whenever it underwent dynamic environmental exposure; and magnetic dipole moment measurements were made. Prelaunch tests and the launch vehicle and orbit are described.
M.W.R.

N66-10320*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INTERSTAGE ADAPTER PANEL FLUTTER ON ATLAS-CENTAUR AC-2, AC-3, AND AC-4 VEHICLES
Tilak R. Lall Washington, NASA, 14 p refs
(NASA-TM-X-1179) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The structural integrity of the interstage, because of its propensity to panel flutter, was studied. A wind tunnel test program, using both individual panels and a full-scale quarter section of the adapter, was conducted to identify the flutter boundary. The AC-2, AC-3, and AC-4 flight vehicles were instrumented to record skin oscillations. The high-frequency pressure fluctuation transducers were included in the instrumentation. Analysis of flight parameters indicated that on each of these flights the vehicle flew essentially outside the flutter boundary (i.e., no flutter); however, flight data established that a high degree of skin oscillations was encountered on each of the flights. Further analysis indicated that these oscillations were forced by sonic and aerodynamic inputs during the flights. Structural integrity of the interstage was maintained through stage separation. It may be concluded that the existing adapter is adequate to withstand the load imposed by the vibration environment.
Author

N66-10328*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FATIGUE OF RENE 41 UNDER CONSTANT- AND RANDOM-AMPLITUDE LOADING AT ROOM AND ELEVATED TEMPERATURES

Edward P. Phillips Washington, NASA, Nov. 1965 30 p refs (NASA-TN-D-3075) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Narrow-band random-amplitude and constant-amplitude bending fatigue tests were conducted on sharply notched Rene 41 specimens at room temperature, 700° F (644° K), and 1400° F (1033° K). When compared on the basis of the root mean square of the nominal peak stresses, the random loading generally gave shorter lives than the constant-amplitude loading. Theoretical life predictions were made for the random-loading tests by using the Palmgren-Miner cumulative-damage rule and two different peak stress distributions (the distribution determined from the tests and the classical Rayleigh distribution). The predictions underestimated the fatigue life in practically all cases. The predicted lives based on the Rayleigh peak distribution were always less than those predicted by using the experimentally determined peak distribution. For both types of loading in the long-life region, a loss of fatigue strength from that at room temperature occurred at 700° F (644° K) but no further loss occurred at 1400° F (1033° K). Author

N66-10332*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

VIBRATION ANALYSIS OF CLUSTERED LAUNCH VEHICLES

Rudolf F. Glaser and Everett E. Beam Washington, NASA, Nov. 1965 67 p refs

(NASA-TN-D-3090) CFSTI: HC $3.00/MF $0.75 CSCL 20K

The Saturn I vehicle represents a complex ensemble of nine beams joined together. A first vibration analysis based on an equivalent single beam did not agree satisfactorily with the test results of the full scale test vehicle. Comparison of analysis and test results rather dictates that the coupling effects of the nine single beam vibrations can not be neglected. Hence, the analysis developed in this paper is based on a model consisting of nine clustered beams. However, the complexity of the system calls for many simplifying assumptions. The basic idea of the analysis consists in coupling of the single beam vibrations such that the connections of the beams will be preserved. The method applied to the uncoupled single beams is the well known transfer matrix method. The mentioned coupling of the single beam vibrations leads to a linear homogeneous system of compatibility equations which must be solved during each transfer. Realization of the boundary conditions leads to a frequency curve indicating the coupled frequencies of the system. Finally the coupled mode shapes can be determined. The analysis is programmed on IBM-709-4. Because it consists of simple matrix operations the computer time is short. The results of an analysis of the Saturn I vehicle compare well with test results. Author

N66-10337*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A FREQUENCY INDEPENDENT TECHNIQUE FOR EXTRACTING THE RIGID-BODY MOTION FROM THE TOTAL MOTION OF A LARGE FLEXIBLE LAUNCH VEHICLE

James C. Howard Washington, NASA, Nov. 1965 57 p refs (NASA-TN-D-3109) CFSTI: HC $3.00/MF $0.50 CSCL 20K

A method was devised for extracting rigid-body motion from the total motion of a flexible body. This method, which does not rely on the relative frequencies of the closed-loop rigid-body control mode and the elastic modes of conventional filters, is well adapted to situations where a flexible-body frequency coincides with, or differs only slightly, from the control mode frequency. It involves the use of processing functions and requires that the number of sensing elements be equal to the number of modes of motions considered. Rejection of spurious, flexible-body motion is accomplished by making the processing function associated with each sensing element a prescribed function of the model slopes or the model displacements. When the processing functions are allocated as prescribed, the information reaching an operator's display panel, or the summing junction where error signals are generated, will not be contaminated by flexible-body motion. R.R.D.

N66-10345# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.

EXPLORATORY TESTS OF CYLINDERS WITH VARIOUS LIGHTWEIGHT STIFFENING SYSTEMS UNDER EXTERNAL HYDROSTATIC PRESSURE

John J. Healey Aug. 1965 24 p refs

(DTMB-2073; AD-620652)

Twelve-machined cylindrical models with length-to-diameter ratios of approximately 5.0 were collapsed under external hydrostatic pressure to study the elastic buckling strength of metallic cylinders stiffened with low modulus, low density, relatively low strength materials. Three different configurations were studied; two-layered shells, continuous-core sandwich shells, and ring-stiffened shells. The test results demonstrated that the use of low modulus materials in various stiffening systems can lead to significant increases in the elastic buckling strength of metallic cylindrical shells. Author (TAB)

N66-10408*# National Aeronautics and Space Administration. Washington, D. C.

STABILITY OF A REINFORCED CIRCULAR CYLINDRICAL SHELL SUBJECTED TO COMPRESSION AND PURE BENDING [USTOYCHIVOST' PODKREPLENNOY KRUGOVOY TSILINDRICHESKOY OBOLOCHKI PRI SZHATII I CHISTOM IZGIBE]

K. D. Turkin Jul. 1963 37 p refs Transl. into ENGLISH from Raschet Prostranstvennykh Konstruktsiy (Moscow), No. 4, 1958 p 477–498

(NASA-TT-F-8298) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Theoretical and experimental studies of stability in a reinforced circular cylindrical shell subjected to central compression and pure bending are presented. The role of shear deformation in the mean surface, and the determination of the critical bending load in the bulging are particularly considered. The introduction of a function K in the calculations makes possible the placement of only weak restrictions on the shift deformation and allows the role of the shift in a generally deformed state of circular cylindrical shells to be investigated during bulging caused by central compression. The hypothesis of the absence of shifts was used in the solution of some problems. The hypothesis allows a problem to be resolved by determining the critical load during the pure bending of a long, circular cylindrical shell. It was shown that, beginning with certain lengths, the shell loses stability along long longitudinal halfwaves with the formation of three halfwaves in a cross-section in the compressed area of the shell. Experimental critical stresses fluctuated within 83% to 100% of theoretical values. L.S.

N66-10418*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

AN EVALUATION OF THE EFFECT OF FINITE SHEAR STRAIN IN A SHALLOW, SPHERICAL SHELL

Harry E. Williams 1 Oct. 1965 27 p refs
(Contract NAS7-100)
(NASA-CR-67741; JPL-TR-32-780) CFSTI: HC $2.00/MF $0.50 CSCL 20K

In an effort to assess the effect of including transverse shear strain in the analysis of thin shells, the equations proposed by E. Reissner are specialized for shallow, spherical shells and are solved for cases of loading for which the effect might be expected to be appreciable. It is found that, for materials that are nearly isotropic, the solution for an edge-loaded shell differs slightly from that of the classical equation. However, the solution in the neighborhood of a concentrated load applied at the apex is found to differ significantly from its classical counterpart. Author

N66-10419*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT OF A POINT DAMPER FOR THE RANGER SOLAR PANELS
M. Gayman 1 Sep. 1965 24 p
(Contract NAS7-100)
(NASA-CR-67750; JPL-TR-32-793) CFSTI: HC $1.00/MF $0.50 CSCL 22B

The increase in solar panel size on Rangers 6 through 9 over those used on prior Ranger flights resulted in intolerably higher structural gains during simulated-launch vibration testing. Rather than adding more solar panel attachments as a remedy, dampers were designed to absorb some of the input energy from the spacecraft. Of the three types of dampers considered, the one selected, on the basis of probable availability within schedule, demonstrated satisfactory reduction of the dynamic gains. The damper design, geometry, and discussion of the assembly and test equipment are included in this report. Data reduction is given in detail, and damper development results are discussed. Author

N66-10487# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET AEROBALLISTIC RANGES AND HYPERVELOCITY RESEARCH Surveys of Communist World Scientific and Technical Literature
Lee Boylan 21 Sept. 1965 69 p refs
(ATD-P-65-79)

The ballistic ranges mentioned in open Soviet literature are described and recent developments in hypervelocity technology in Poland and the Soviet Union are discussed. Also, Soviet impact studies, techniques, and equipment are reviewed. Soviet work on shock tubes and instrumentation for hypervelocity experimentation are covered. The material presented is the result of a comprehensive review of more than 15 major Soviet scientific periodicals and other pertinent publications. Over 3000 articles were reviewed. E.E.B.

N66-10488# Lockheed Missiles and Space Co., Sunnyvale, Calif.
USE OF THE SMALL PARAMETER METHOD TO ANALYZE THE STRESSED STATE OF SHALLOW SHELLS
Ia. F. Kaiuk and M. K. Alekseeva [1965] 5 p refs Transl. into ENGLISH from Prik. Mekh. (Kiev), v. 1, no. 7, 1965 p 45–49

The nonlinear problem of the stressed state of a shallow shell under the effect of a uniformly distributed loading is considered. The solution of the problem for comparatively low shallowness of the shell and large deflections is represented as a two-parameter expansion. The method generalizes the method previously proposed for flexible circular plates. The solutions presented are valid for small values of the parameters. By using the analytical continuation by replacement of parameters, solutions for comparatively large values of the parameters may be obtained. The method can be used to analyze the stressed and strained states of other comparatively shallow shells of revolution. E.E.B.

N66-10550# National Research Council of Canda, Ottawa (Ontario).
A SIMPLE METHOD FOR THE SOLUTION OF LOADED PLATE PROBLEMS [EIN EINFACHES VERFAHREN ZUR LOSUNG VON SCHEIBENAUFGABEN]
W. Schleeh 1965 47 p refs Transl. into ENGLISH from Beton- Stahlbetonbau (W. Berlin), v. 59, no. 3 p 49–56; no. 4 p 91–94; no. 5 p 111–119
(NRC-TT-1190) CFSTI: HC $2.00/MF $0.50

The stress distribution in deep beams and locally in the areas near concentrated loads, was developed from the relationships between the elementary Navier theory and the rigorous theory of bending, as represented by the plate theory. The known theorems for the infinitely long plate with parallel edges were expanded to the rectangular plate with three or four edges in the finite region. States of supplementary stress in the sections perpendicular to the axis of the rod were represented as corrections of the stress curve without a resultant of their own, and the influence values of the supplementary stresses were found for the most important boundary conditions. This method is applicable to continuous plates with statically indeterminate supports, provided the modified elastic conditions in the plate are taken into account. G.G.

N66-10570# Geophysics Corp. of America, Anoka, Minn. Viron Div.
AEROSPACE EXPANDABLE STRUCTURES AND MAINTENANCE SUPPORT DEVICES. VOLUME I: EXPANDABLE SELF-RIGIDIZING SOLAR ENERGY CONCENTRATORS AND AEROSPACE SHELTERS FROM HONEYCOMB TYPE FABRIC Technical Report, 9 Dec. 1963–2 Nov. 1964
Ronald Rochon, Robert C. Clark, Nels S. Hanssen, and William J. Mc Killip (Archer–Daniels–Midland Corp.) Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jul. 1965 168 p refs Prepared jointly with Archer–Daniels–Midland Co.
(Contract AF 33(615)-1243)
(AFADL-TR-65-40, Vol. I; AD-471333)

Materials and techniques were improved to advance the concept of expandable, self-rigidizing honeycomb type structures. The strength to weight ratio of structures was markedly improved through the correct utilization of inflatable configurations with a high degree of structural rigidity. A rigidizing resin was developed with an improved strength/weight ratio, a more rapid cure time, and a good shelf life. Solar collectors with reasonably good optical reflectivity and aerospace shelters were fabricated, expanded, and rigidized. Two large sized structures suitable for space application were constructed as end items of this study. Those structures werd a 10 foot diameter, 60 degree rim angle solar energy concentrator and a 13 × 15 ft semi-cylindrical aerospace maintenance dock. Both structures utilized a resin impregnated honeycomb type fabric construction and were inflated and rigidized from a packaged configuration. The maintenance dock was successfully designed for 30 psf gravity and 100 mph wind loads. Both structures significantly advanced the concept of expandable, self-rigidizing structures by their size, construction, and performance. Author (TAB)

N66-10573# Forest Products Lab., Madison, Wis.
EFFECT OF CORE THICKNESS AND MOISTURE CONTENT ON MECHANICAL PROPERTIES OF TWO RESIN-TREATED PAPER HONEYCOMB CORES

Paul M. Jenkinson Sep. 1965 26 p Mil. Handbook No. 23, Item 62-2
(Contract AF 33(615)65-5002)
(FPL-35; AD-438020)

The dimensional movement across the grain of nominal 1-inch pine lumber is greatly reduced when the lumber is overlaid on both sides with a suitable resin-impregnated kraft sheet whose machine direction is parallel to the lumber grain. Certain vulcanized fiber sheets as well as parchmentized paper sheets can be bonded to only one side of a flat-grain pine board so that the machine direction of the sheet is parallel to the grain of the lumber, and little or no increase in warping tendencies occurs. The paint retention characteristics of lumber siding such as flat-grain southern pine or other species are greatly improved by the use of overlays. Overlay materials of this type should form a suitable base material for factory application of finishes for exterior service. Lumber manufacturers are also looking at other synthetic film-finishing materials, which incorporate both the overlay and the finish in a single film to be bonded to the surface. The most promising of these at the present time appear to be chlorosulfonated polyethylene and polyvinyl fluoride. Author(TAB)

N66-10604*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INFLUENCE ON THE BUMPER AND MAIN WALL MATERIAL ON THE EFFECTIVENESS OF SINGLE METEOROID BUMPERS
Donald H. Humes Washington, NASA, Nov. 1965 31 p refs
(NASA-TN-D-3104) CFSTI: HC $2.00/MF $0.50 CSCL 20K

An experimental investigation was conducted to determine the relative effectiveness of single aluminum, beryllium, lead, magnesium, Mylar, neoprene, and stainless-steel meteroid bumpers and the relative effectiveness of aluminum, beryllium, lead, magnesium, and stainless-steel main walls in reducing the total penetration damage produced by 1.59-mm-diameter aluminum projectiles at velocites up to 5.88 km/s. The maximum total penetration damage was found to be a function of the mass per unit area of the bumper and to be independent of the bumper material. The maximum total penetration damage and the optimum bumper mass were functions of the main wall material, the less dense main wall materials being generally more effective. The optimum bumper mass against the 1.59-mm-diameter aluminum projectiles was independent of the bumper material and was approximately 1 kg/m^2 when a finite-thickness aluminum main wall was used and 3 kg/m^2 when a finite-thickness lead main wall was used. Author

N66-10676*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPRESSION TESTS ON INTEGRALLY STIFFENED CYLINDERS
Lester Katz 6 Aug. 1965 111 p refs
(NASA-TM-X-53315) CFSTI: HC $4.00/MF $0.75 CSCL 20K

Uniform axial compressive loads were applied to 23 unpressurized circular cylinders until failure by buckling occurred. Twenty-one of the cylinders were integrally stiffened, with stringer and frame patterns that may be described as: 0°-90° waffle, 45° waffle, and stringer-only configurations. Experimentally determined buckling loads for general and local instability were compared with analytical predictions. Relative structural efficiencies were obtained for the various patterns tested and experimental stress distribution data were determined for all the test cylinders. Author

N66-10728# Joint Publications Research Service, Washington, D. C.
OSCILLATION ENERGY FLOW AS A CRITERION FOR A MECHANISM'S VIBRATION
M. D. Genkin and V. V. Yablonskiy 25 Oct. 1965 8 p refs Transl. into ENGLISH from Mashinoved. (Moscow), no. 5, Sep./Oct. 1965 p 55-58
(JPRS-32533; TT-65-33012) CFSTI: $1.00

For more accurate evaluation of a mechanism's sound emission, oscillation energy flow was proposed as a criterion for vibrational activity. Measurement methods were developed, based on a special measuring complex and the frequency characteristics of the oscillating system. The mechanism-foundation-base system is illustrated, and the definite parameters for the sound frequency range are discussed. Equations are given for the energy flow in the transverse section of the oscillating system, and for energy flow and frequency characteristics. Also discussed are direct and indirect systems which were used to measure oscillation energy flow on large reductor foundations with various technological parameters and modes of operation. Findings indicate that at certain points of rigid foundations, the flow of energy is directed back to the source. M.G.J.

N66-10769# Naval Applied Science Lab., Brooklyn, N. Y.
FATIGUE OF STRUCTURAL ELEMENTS: DEVELOPMENT OF THEORY AND MEASUREMENT OF RESIDUAL STRESSES AT TEE FILLET WELDS IN 1-1/2 IN. HY-80 STEEL Progress Report
Hugo V. Cordiano, Wolodymyr Werchniak, and Barry S. Silverman 13 Sep. 1965 71 p refs
(PR-1; AD-620234)

A theory has been developed for the calculation of relaxation strains when a hole is drilled into a plate with a linearly varying stress field. With this theory a technique was developed for the measurement of residual stresses at the toe of tee fillet welds. The above technique was employed for the measurement of residual stresses at the toe of tee fillets in 1-1/2 in. HY-80 steel with the fillet in the as welded, ground, shot-peened, ground and shot-peened, and mechanically-peened condition. It was found that experimental data conform to the assumed theory, and that residual stresses in as welded tee fillet welds in both the transverse and longitudinal directions approach the yield strength of the steel. It was also found that residual stresses are reduced approximately 25 percent by grinding, 50 percent by shot peening and 50 percent by grinding and shot peening. Mechanical peening drastically affected residual stresses by converting high tension at the toe of the fillet weld to high compression of approximately the same magnitude. Author(TAB)

N66-10790# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF A CORRUGATED CYLINDRICAL SHELL LOADED BY AN EXTERNAL PRESSURE
V. F. Chizhov and N. E. Bauman 1 Jun. 1965 21 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), no. 3, 1964 p 35-46
(FTD-MT-64-518; AD-620965)

In the article there are examined the different variants of structural design solution and the selection of the force diagram depending upon geometric dimensions and magnitude of the external pressure. On the basis of the obtained solution it is shown that under certain relationships of the parameters it is more advantageous, from the point of view of weight, to

use shells corrugated in the annular direction of the shell, and stiffened in axial direction by elastic fibers. Results of experimental data on field test-pieces and models are presented. Author (TAB)

N66-10811# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF DISPERSION CHARACTERISTICS OF CENTRIFUGAL INJECTOR NOZZLES OF GREATER PRODUCTIVITY
R. B. Akhmedov, L. M. Tsirul'nikov, A. D. Gorbanenko, and B. L. Zharkov 18 Aug. 1965 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Tekhn. Nauk (Tashkent), v. 6, 1964 p 66–73
(FTD-TT-65-1113/1+2+4; AD-620805)

An increase in diameter of output opening on injector nozzle changes the effect of liquid pressure and structural parameters of the nozzle on the fineness of fuel dispersion. The existing semi-empirical criterial ratios, obtained during the study of low yield nozzles, cannot be used to determine the characteristic dimensions of liquid droplets, dispersed by nozzles of greater yield. Injector nozzles of greater yield of A type possess better dispersion qualities than B type nozzles. Author (TAB)

N66-10858# Illinois Univ., Urbana.
FREE AND FORCED VIBRATIONS OF SPHERICAL SHELLS
M. S. Zarghamee (Ph.D. Thesis) and A. R. Robinson Jul. 1965 138 p refs *Its* Rept.-293
(Contract Nonr-1834(03))
(AD-620906)

The purpose of the investigation is to study the free vibrations of a spherical shell segment with figidly clamped boundary, and to compute the response of such a shell segment to realistic loading resulting from a blast wave. The study is limited to cases for which the material stays linearly elastic, and strains and rotations remain small. Two methods of analysis are developed for the free vibrations of the spherical shell segments. TAB

N66-10869# Oklahoma Univ. Research Inst., Norman.
STRENGTH PROPERTIES AND RELATIONSHIPS ASSOCIATED WITH VARIOUS TYPES OF FIBERGLASS-REINFORCED FACING SANDWICH STRUCTURE Final Report, 25 Sep. 1962–31 Jul. 1964
Gene M. Nordby and W. C. Crisman Aug. 1965 86 p refs
(Contract DA-44-177-AMC-893(T))
(USAAVLABS-TR-65-15; AD-621522)

Contributions to the acceptance of fiberglass-reinforced plastic (FRP) as an aircraft structural material were made through verification of existing theoretical strength relationships by the fabrication and testing of sandwich panels in the laboratory. The four basic failure modes were investigated for sandwich plates and plate columns loaded in edgewise compression. These were general buckling, face wrinkling, shear crimping and face dimpling. To achieve these modes, it was necessary to vary not only the specimen size and boundary conditions but also, in many cases, the dimensions and composition of the constituent materials. In the development of a suitable structural sandwich, a number of advances were made in the realm of fabrication. These include the development of a multi-ply pre-preg, the establishment of a precure phase in the resin cure cycle as a control of resin flow, and the use of the separately-bonded type of sandwich construction. The effect of adhesive filleting on the core strength and the effect of laminate thickness on facing strength properties were also isolated. Author (TAB)

N66-10871# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF FRAMED CIRCULAR CYLINDRICAL SHELLS DURING THE ACTION OF AXIAL COMPRESSION AND TRANSVERSE PRESSURE
S. N. Kan and D. Ye. Lipovskiy 27 May 1964 19 p ref Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 4, 1962 p 79–90
(FTD-MT-63-289; AD-619557)

One of the most important problems in the design of engineering structures is the determination of the carrying capacity of a structure. A component element of this problem is the calculation of critical stresses during the action of compressive loads. The present work, devoted to the stability of framed circular cylindrical shells, is the first of three articles, in which an attempt is made to solve the problem of calculation of the carrying capacity of the indicated structures. TAB

N66-10881*# Case Inst. of Tech., Cleveland, Ohio. Engineering Design Center.
THE SYNTHESIS OF A LAMINATED PLATE FOR HIGH TEMPERATURE APPLICATION
Lucien A. Schmit, Jr. and David E. Kinser Jul. 1964 86 p
(Grant NsG-110-61)
(NASA-CR-67703; EDC-2-64-7) CFSTI: HC $3.00/MF $0.75 CSCL 20K

This work presents the application of the synthesis idea to a system with a thermoelastic technology. The system is a three layered plate: the outer two layers of ceramic material for thermal protection and the third layer of metal for structural purposes. There are six design parameters: the density and the depth of each layer. The behavior constraints are the temperatures at the surface and the two interfaces and the stresses at the upper and lower boundaries of the third layer. Side constraints are provided on the six design parameters. The merit function is the weight per unit surface area of the plate. A steepest-descent alternate step synthesis method is used. Results of three example syntheses are included with a discussion of a possible pseudo-design parameter. The results indicate that a thermo-elastic system may be successfully synthesized. Author

N66-10885*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
RF TRANSPARENT, ENERGY ABSORBING, STRUCTURAL ELEMENTS, PHASE II Final Report, 5 Jun. 1963–16 Mar. 1964
W. M. Meyers and H. G. Lorsch 17 Aug. 1964 177 p refs Prepared for JPL *Its* Doc. No. 64SD4329
(Contracts NAS7-100; JPL-950564)
(NASA-CR-67776) CFSTI: HC $5.00/MF $1.00 CSCL 20K

This is the final report of Phase II of a project for the development and testing of energy absorbing, structural elements having high specific energy absorption and low dielectric constant and loss tangent. The design objective was to improve the mechanical properties of the material developed in Phase I, to determine the effect of angular impact on the material, and to establish the manufacturing limitations in forming the developed material to singly and doubly curved contours. Details of the design, fabrication, testing, and performance of the system are included. Author

N66-10937*# General American Transportation Corp., Niles, Ill. Research Div.
TRANSPORTATION SHOCK AND VIBRATION, VOLUME 2, APPENDIX D Final Report

Sep. 1965 347 p refs
(Contract NAS8-11451)
(NASA-CR-67940; MR-1262) CFSTI: HC $7.00/MF $1.75 CSCL 20K

Transportation shock and vibration data for the design criteria manual are reported. Included are data on railroad freight cars, aircraft velocity pickups, cargo vans, and instrumentation.
S.C.W.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N66-10045*# General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
FLOW FIELD PREDICTION AND ANALYSIS, PROJECT FIRE
M. J. Brunner, C. V. Dohner, V. A. Langelo, and H. Rie 29 May 1964 113 p refs *Its* Doc. No.-64SD727
(Contract NAS1-3418)
(NASA-CR-60451) CFSTI: HC $4.00/MF $0.75 CSCL 20M

Flow field prediction and analysis was determined for the Project FIRE vehicle at flight conditions of 34,582 ft/sec velocity and 171,611 feet altitude for basically equilibrium conditions at zero angle of attack. The flow field predictions were made for the shock shape, local velocity, density, temperature and specie concentration over the vehicle. The heat transfer predictions were made for both the convective (laminar and turbulent) and radiative heat flux input over the vehicle. The spectral distribution was determined at the stagnation point.
Author

N66-10093# Joint Publications Research Service, Washington, D. C.
STEAM GENERATION PROBLEMS IN THE LIGHT OF MODERN TRENDS IN HEAT ENGINEERING
M. A. Styrikovich 6 Oct. 1965 11 p Transl. into ENGLISH from Teploenerg. (Moscow), v. 12, Aug. 1965 p 2-6
(JPRS-32297; TT-65-32787) CFSTI: $1.00

The scientific problems connected with steam generation are assessed in terms of the new techniques and methods of generating electrical power. The essentiality of the steam generator in steam or gas turbine installations is cited along with its role in magneto-hydrodynamic and nuclear power plants. The study takes into consideration the effect of fuel on the horsepower and parameters of steam turbine units and it covers basic trends and problems in fuel combustion and in internal boiler processes.
C.L.W.

N66-10128# Brookhaven National Lab., Upton, N. Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW: A BIMONTHLY TECHNICAL PROGRESS REVIEW, VOLUME 3, NUMBER 3, JUNE 1965
C. R. Fisher et al Sep. 1965 73 p Sponsored by AEC
(BNL-939(PR-15)) CFSTI: $3.00

Topical reports and reviews of research programs in high temperature liquid-metal technology are presented. Data are reported under the following subject headings: physical properties and thermodynamics; fluid dynamics; heat transfer; material development and corrosion; instrumentation; component development; systems studies; and chemical analysis and chemistry.
S.C.W.

N66-10152 Naval Research Lab., Washington, D. C. Organic and Biological Chemistry Branch.
PASSIVE THERMAL CONTROL IN A SPACE ENVIRONMENT
A. L. Alexander *In its* Rept. of NRL Progr. Feb. 1965 p 1-9 refs (See N66-10151 01-34)

Thermal control within a fairly narrow range is essential to the proper functioning of many electrical, biological, and optical systems employed in spacecraft. Active control systems either heat or refrigerate the environment in question and suffer from the disadvantages of adding extra weight and providing the possibility for malfunction of moving parts. Passive systems, on the other hand, regulate radiation of internal heat or excessive absorption of external heat. Work at NRL has concentrated on developing coatings which will maintain the balance between absorption and emission within any prescribed limits. Many systems have been evaluated, including silicone varnishes and pigmented resins.
Author

N66-10186# Commissariat a l'Energie Atomique, Grenoble (France).
HEAT TRANSFER WITH ORGANIC FLUIDS [TRANSFERTS DE CHALEUR PAR LIQUIDES ORGANIQUES]
F. Lanza (EURATOM), Roger Ricque, and Jean-Paul Villeneuve 1964 17 p refs In FRENCH; ENGLISH summary
(CEA-R-2644) CFSTI: HC $1.00/MF $0.50

Using a test channel with a circular cross section of 12 mm internal diameter the following heat transfer correlation, valid to about ±6 p. 100, was determined for the terphenyls OMP and OM2 with 0, 10, 20, or 30 p. 100 of high polymers: $Nu_b = 0.00835\ Re_b^{0.9}\ Pr_L^{0.4}$ This correlation was established with fluxes ranging from 50 to 100 W/cm^2, temperatures from 290° to 420° C, and Reynolds number from 30 000 to 350 000. Eight long-term tests were carried out (250 to 1000 hours continuous running) to determine how deposition on the heating surfaces affects the exchange coefficient. The loop is made of stainless steel except for one part in soft steel. No deposits are observed even if the terphenyl contains 30 ppm of chlorure, while on the other hand deposition is appreciable when heavy substances containing combined oxygen are added.
Author

N65-10204# California Univ., Berkeley.
THE EFFECT OF MASS INJECTION ON HEAT TRANSFER FROM A PARTIALLY DISSOCIATED GAS STREAM
Robert Nelson Meroney (Ph.D. Thesis) May 1965 156 p refs
(AD-467171)

The effect of light molecular weight gas injection on the heat transfer to a porous surface from a partially dissociated turbulent boundary layer was investigated experimentally and analytically. A dimensionless blowing parameter which successfully related the experimental results for heat flux with injection to heat flux without injection was developed.
Author (TAB)

N66-10214*# Emerson Electric Mfg. Co., St. Louis, Mo. Electronics and Space Div.
PERFORMANCE EVALUATION OF "THERMO-LAG" MATERIAL FOR ENTRY HEAT PROTECTION OF ADVANCED MANNED SPACECRAFT Quarterly Progress Report, 1 Jan.-1 Apr. 1963

[1963] 188 p refs *Its* Rept.-1533
(Contract NAS9-877)
(NASA-CR-65167) CFSTI: HC $5.00/MF $1.25 CSCL 20M

Emphasis is placed on obtaining test data for environmental, solid-state thermal, and mechanical properties of Thermo-Lag T-500 materials. Solid-state thermal properties that would characterize these materials for low vacuum space environment, and the modes of heat transfer were determined. An analysis of the design of the model for the gap tests was conducted. Test results for tensile strength and elongation, shear strength, flexural strength, and ultraviolet exposure mechanical properties are given. Research studies regarding debris layer oxidation were conducted, and checkouts were made on the IBM numerical ablation programs. Air-arc flight simulation tests conducted for transient heating studies are analyzed for parameter evaluation of the ablation model. Surface treatment techniques and secondary bonding materials were investigated, and bond shear and tensile tests were made in a selection study of an appropriate bonding material. An artificial technique to cure Thermo-Lag T-500 putty is included. C.T.C.

N66-10324*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A COLD GAS, SHORT DURATION TECHNIQUE FOR HIGH ALTITUDE, UNDEREXPANDED JET EXHAUST IMPINGEMENT STUDIES
A. J. Gopin and E. L. Margolin Washington, NASA, Nov. 1965 53 p refs
(NASA-TN-D-2943) CFSTI: HC $3.00/MF $2.00 CSCL 21H

A short duration, cold flow test technique which experimentally duplicates the pressure effects of underexpanded free hot rocket exhaust jets impinging upon adjacent surfaces is described. The technique lends itself to any type of high altitude test cell with a minimal amount of simulated pressure altitude decay. The theory to justify the use of cold gases to simulate hot rocket exhaust is given, and short duration runs, i.e., as low as fifteen milliseconds, are shown to be feasible and within the state of the art. The application of these two techniques—cold gas and short run times—permits the use of non-cryopumped vacuum tanks, thereby significantly reducing the cost of testing when compared to continuous hot or cold flow test methods now in common use. The hardware required to use these techniques is also described. The device was developed for use in determining the exhaust impingement forces on the Saturn S-IC/S-II interstage during its separation from the Saturn S-II stage. Author

N66-10327*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
AN INVESTIGATION OF HEAT TRANSFER WITHIN REGIONS OF SEPARATED FLOW AT A MACH NUMBER OF 6.0
Paul F. Holloway, James R. Sterrett, and Helen S. Creekmore Washington, NASA, Nov. 1965 98 p refs
(NASA-TN-D-3074) CFSTI: HC $3.00/MF $0.75 CSCL 20M

An extensive systematic investigation of the heat transfer associated with regions of laminar, transitional, and turbulent separation has been conducted on sharp- and blunt-leading-edge flat plates at a Mach number of 6.0 over a free-stream unit Reynolds number range of approximately 1×10^6 to 8×10^6 per foot. Separated regions were forced by forward- and rearward-facing steps, and by 10°, 20°, 30° and 40° wedges located in several longitudinal positions on the plate. It has been shown that upon proper classification of the several types of separated flow, the trends of the heating rates within the regions of separation may be characterized by typical distributions which are essentially independent of the model geometry (except to the extent that the model-geometry variations affect the location of transition). In particular, the local heating in the separation region is less than or greater than that on the flat plate without separation for the case of pure laminar or turbulent separation, respectively. Author

N66-10374# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
THERMAL RADIATION OF COMPLEX CERAMIC SOLIDS
Albert F. Grenis Jul. 1965 19 p refs
(AMRA-TR-65-14; AD-620004) CFSTI: $1.00

The normal total emissivities and relative radiant intensities of several complex ceramic oxides were determined theoretically. It was found that the total emissivities for many of the complex solids seemed nearly to follow the equation which states that the normal total emissivity of a complex solid is equal to the sum of the products of the normal total emissivity and the ratio of the mass/densities (relative volume ratio or the mole ratio) of each of the compounds initially present. On a molecular basis, it was found that the vibratory modes of many of the complex ceramic compounds are nearly similar to the cumulative vibratory modes of the simple ceramic compounds. Author (TAB)

N66-10449# Oak Ridge National Lab., Tenn.
AN APPARATUS TO MEASURE THE THERMAL CONDUCTIVITY OF POOR CONDUCTORS AT 1000° C, PART B
N. N. Engel and D. L. Mc Elroy [1964] 9 p refs
(Contract W-7405-ENG-26)
(CONF-764-9)

A radial heat flow system, which uses a single movable thermocouple to measure the radial temperature distribution, was developed for measuring the thermal conductivity of poor conductors to 1000° C. Initial measurements were completed on a low density thermal insulation (carbon felt, type VDF) in vacuum to 600° C, in air to 300° C and in helium to 100° C. The results in vacuum were fitted by an $A + BT^3$ relation, which implies a constant heat transport contribution due to the carbon felt and a T^3 radiation dependence that was only 40% of the calculated exchange expected from radiation in the absence of the specimen. By adding the known thermal conductivities of the two gases to this expression, we obtained equations that represented well the thermal conductivity measured with the two gases present. Thus carbon felt insulation blocks direct radiation transport and gaseous convection, but not gaseous conduction. Author

N66-10462# Geoscience Ltd., La Jolla, Calif.
HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS Quarterly Technical Report, 1 Mar.–31 May 1965
H. F. Poppendiek et al [1965] 11 p refs
(Contract AT(04-3)-409)
(GLR-36; SAN-409-24)

Research on high temperature liquid metals is described. Information on experimental and predicted vaporization lifetimes for potassium droplets on a heated tantalum surface is presented. Also vaporization lifetime measurements for Freon 114 drops are shown and compared to the earlier results for Freon 11. Results of an accuracy analysis for the previously reported forced flow boiling potassium conductance measurements are also presented. Author (NSA)

N66-10468# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
A PROGRAM OF TWO-PHASE FLOW INVESTIGATION Eighth Quarterly Report, Jan.–Mar. 1965
G. Bijwaard, F. W. Staub, and N. Zuber 10 Apr. 1965 39 p. refs
(Contract AT(04-3)-189)
(GEAP-4844) CFSTI: $1.75

Experimental data are presented on the transient response of the vapor volumetric concentration in a boiling fluid flowing upward in a vertical circular tube. Experiments were performed by oscillating the power input to the metal test section while maintaining a constant discharge pressure and a constant inlet liquid velocity. The amplitude of the power oscillations varied between 5 and 40% of the average power at frequencies between 0.01 and 10 cycles per sec. Results are compared to values predicted by the void propagation equation which is formulated in terms of kinematic waves. Agreement is good between predicted and measured values. Oscillation in the test section is predicted satisfactorily using the measured void faction to calculate the momentum and hydrostatic head and employing the Martenelli-Nelson method to obtain the friction pressure drop. Pressure drop oscillation is less than the measured value at the frequency where a maximum in this pressure drop amplitude takes place. A computer solution and an approximate closed form analytical solution of the void propagation equation are presented for the case when the oscillatory power input to the liquid is of the form $(1 + \epsilon \sin \omega t)$. R.N.A.

N66-10575# ARO, Inc., Arnold Air Station, Tenn.
SCALING OF TRANSIENT TEMPERATURE DISTRIBUTIONS OF SIMPLE BODIES IN A SPACE CHAMBER
D. L. Adkins Arnold Eng. Develop. Center, Oct. 1965 21 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-65-177; AD-471212)

Thermal scaling of bodies with cycled internal heat sources was investigated in a cold high vacuum environment. Modeling relations were derived and tests carried out in two configurations. The first array of bodies consisted of a flat plate, sphere, and cylinder arranged in a close network but not in physical contact with each other. The second system consisted of two spheres connected by a cylindrical rod. Material and characteristic temperatures were preserved between the prototype and model. The experimental transient temperature distributions in the models were in agreement with the scaling relations.
Author (TAB)

N66-10619*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
ROCKET BASE FLOW FIELD STUDIES USING AN ELECTRON BEAM PROBE Quarterly Progress Report No. 1, 25 Jun.–25 Sep. 1965
[1965] 13 p refs
(Contract NSR-33-009-030)
(NASA-CR-67880) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A program is being conducted to extend the electron beam rotational temperature measurement technique to the state where a system capable of making a base flow field survey of a scale model rocket vehicle will be realized, and to determine the practicality of adapting the electron beam probe to density measurements in the base region flow of scale model rockets in the presence of combusted gases. Modifications in the optical instrumentation of the rotational temperature measuring apparatus are discussed. A tentative test plan is outlined for demonstrating the feasibility of obtaining temperature measurements. Preliminary studies were begun on the applicability of the electron beam probe technique to measure density in flows of hot combusted gases. R.N.A.

N66-10628*# Northrop Space Labs., Hawthorne, Calif.
RESEARCH AND DEVELOPMENT STUDY ON THERMAL CONTROL BY USE OF FUSIBLE MATERIALS Interim Report, Mar. 1964–Jan. 1965
A. P. Shlosinger and E. W. Bentilla Feb. 1965 92 p refs
(Contract NAS8-11163)
(NASA-CR-67695; NSL-65-16) CFSTI: HC $3.00/MF $0.75 CSCL 20M

Research and development studies are reported in a program for applying the melting and solidification of materials to the thermal control of space vehicle subsystems. A literature search was made, and fusible materials selected. These are normal (n-) paraffins containing from 14 to 30 carbon atoms. The required thermophysical properties required for the analysis and packaging design were determined. An analysis of two temperature control techniques was made, and an experimental verification of a temperature control package design was initiated. C.T.C.

N66-10687*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMPARISON OF TWO EMITTANCE MEASUREMENT TECHNIQUES
James B. Heaney Sep. 1965 20 p refs
(NASA-TM-X-55294; X-713-65-354) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A technique used to measure total normal emittance that employs a Gier–Dunkle portable emissivity inspection system is explained in detail. This is then compared with the familiar heated cavity hohlraum type measurement which gives a value of total normal emittance by summing spectral data. Emittance values obtained from samples measured on both systems are compared, and an analysis of some of the errors inherent in each measuring technique is given. Author

N66-10700# Brookhaven National Lab., Upton, N. Y.
HEAT TRANSFER IN PARALLEL-PLATE CHANNEL WITH PERIODIC BOUNDARY CONDITIONS
Chia-jung Hsu 18 May 1964 12 p refs Sponsored by AEC
(Contract AT(30-2)-GEN-16)
(BNL-8186)

Heat transfer to fluids flowing inside parallel plate channels with wall temperature or wall heat flux varying periodically was investigated to illustrate the behavior of Nusselt numbers in such a process under the assumption of slug flow between parallel plates. Theoretically analyzed is a general case of fluid flow with uniform heat generation (starting at $z=0$) from which expressions were developed for obtaining the Nusselt number for any section with no internal heat generation; for the case where uniform but different heat fluxes are maintained at the walls of the sections; for the constant temperature case; and for the constant heat flux case. Results of computer calculations are included. S.C.W.

N66-10714*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOCAL TURBULENT HEAT TRANSFER FOR WATER IN ENTRANCE REGIONS OF TUBES WITH VARIOUS UNHEATED STARTING LENGTHS
James R. Stone Washington, NASA, Nov. 1965 24 p refs
(NASA-TN-D-3098) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Local heat-transfer coefficients in the entrance region for water in turbulent forced flow through circular tubes of 0.23- and 0.48-inch inside diameters, square-edged entrances, and uniform heat flux were experimentally determined. Data were

obtained with several different unheated lengths of tubing immediately upstream of the electrically heated section (unheated length to inside diameter ratios of 0.8, 1.6, 6.0, and 15). The data were taken in the turbulent flow regime with Reynolds numbers from 8000 to 118000 over a range of liquid bulk temperatures from 66° to 250° F (Prandtl numbers range from 1.45 to 7.25). The mass flow rate, heat flux, test section exit pressure, water bulk temperatures at the inlet and outlet (with corresponding inlet and outlet Reynolds and Prandtl numbers), and the axial temperature distribution for each run are presented in tabular form. A correlation is presented in terms of local bulk Nusselt, Reynolds, and Prandtl numbers, and geometric parameters valid for Prandtl numbers between 0.7 and 7. Author

N66-10731# McGill Univ., Montreal (Quebec). Gasdynamics Research Lab.

ON TRANSITION FROM DEFLAGRATION TO DETONATION

Isaac Shanfield Aug. 1964 122 p refs

(Grant NRC G-1255)

(MERL-TN-64-2; GD-22) CFSTI: HC $4.00/MF $1.00

Combustion and transition phenomena in a cylindrical containing vessel were investigated, with a streak camera used to observe the process. Experiments were conducted in an equimolar acetylene–oxygen mixture at an initial pressure of 100 mm Hg and an initial temperature of 300° K. Exploding copper wires of .003 and .006 in. diameters were used, with ignition energies from .6 to 9.23 joules per cm width of the cylindrical containing vessels. A critical ignition energy existed above which a detonation was instantaneously formed at the ignition source, and below which normal burning was initiated. Critical energy was .9 joules per cm for the .003 in. wire, and 4.83 joules for the .006 in. wire. Cylindrical flame interaction with the precursor shock was observed, and qualitative agreement was indicated with the results predicted by a simplified theoretical model. True transition was not observed; pseudo-transition occurred in some cases when most of the mixture was consumed. Cylindrical transition was observed when turbulence was artificially generated by a spiral coil mounted on the container sidewall. Cylindrical retonation waves were observed at the onset of detonation. Author

N66-10742# Fiat S.p.A., Turin (Italy). Sezione Energia Nucleare.

FORCED CONVECTION BURNOUT AND HYDRODYNAMIC INSTABILITY EXPERIMENTS FOR WATER AT HIGH PRESSURE. PART I: PRESENTATION OF DATA FOR ROUND TUBES WITH UNIFORM AND NON-UNIFORM POWER DISTRIBUTION

F. Biancone, A. Campanile, G. Galimi, and M. Goffi (Soc. Ric. Impianti Nucleari, Saluggia, Brussels, EURATOM, Aug. 1965 105 p

(Contract EURATOM-008-61-12 PNII)

(EUR-2490.e) CFSTI: HC $4.00/MF $0.75

Burnout and hydrodynamic instability data are presented in this report for a first series of experiments performed on round tubes over a wide range of conditions. The effect of nonuniform power distribution along the heater on burnout power as well as on the location of the point at which burnout inception occurs, has been investigated. A description of the experimental facility and test sections employed is also included. Author

N66-10745*# Georgia Inst. of Tech., Atlanta.

HEAT TRANSFER TO A GAS CONTAINING A CLOUD OF PARTICLES

J. Andrew Mc Alister, Edward Y. H. Keng, and Clyde Orr, Jr. Washington, NASA, Nov. 1965 196 p refs

(Grant NsG-273)

(NASA-CR-325) CFSTI: HC $6.00/MF $1.25 CSCL 20M

The specific radiation process in which energy is transferred from a cylindrical enclosure to a particle cloud within was investigated. The theoretical portion sought general complementary analytical solutions for predicting the behavior of systems which differed from the experimental one. The experimental study was made to obtain direct basic data about the process, unaffected by other heat transfer phenomena; a nonreflective wall radiating to essentially nonreflective particles was used. A combined analytical and numerical procedure was developed to solve the basic radiation equation describing the radiant heat transfer; a generalized graph, prepared from theoretical concepts, describes the rate of heat absorption by the particle cloud in terms of cylinder wall radiation intensity, cylinder length and radius, and particle cloud attenuation constant. Experimental findings indicate that radiation properties of a dispersion may be characterized by particle concentration; total particle cross section area; and total particle volume, determined from precise, statistical measurements of particle size histograms. M.G.J.

N66-10781# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

PRELIMINARY ONE-DIMENSIONAL INVESTIGATION OF THE INITIATION OF LOW-DENSITY PETN BY HYDROGEN-OXYGEN DETONATION WAVES

A. H. Makomaski Feb. 1965 55 p refs

(Contract AF 33(657)-7874)

(UTIAS-TN-93; AD-621448)

Various aspects of the problem of initiation of a uniform layer of PETN by head-on collisions of plane hydrogenoxygen detonation waves are considered. It was found that low-density (1 gm/cc and 0.87 gm/cc) disc pressings of PETN 1.5 in. dia. × 0.15 in. thick consistently appeared to detonate when the initial pressure of the stoichiometric hydrogen-oxygen mixture was about 13 atm or more and the length of the detonation tube was approximately 4 in. Detonation of the PETN was inferred from the deformation of the steel containers which held the pressings rather than from a direct measurement of detonation velocity in the pressing. It was not possible to verify in the tests whether the detonations were of high order. Author (TAB)

N66-10791# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STRESS RUPTURE TEST OF MATERIAL IN LIQUID METAL UNDER CONDITIONS OF MASS TRANSFER

V. I. Nikitin 28 May 1965 8 p refs Transl. into ENGLISH from Zavodsk. Lab. (Moscow), v. 30, no. 2, 1964 p 213–215

(FTD-TT-65-143/1+2; AD-620063)

Tests made in the air, in a motionless liquid metal, and under conditions of transfer of mass in accordance with the proposed procedure showed that in the last case the endurance strength for 1,000 hours proved to be lower by a factor of two than in the first two cases. The method enables one to obtain the characteristics of heat resistance closer to the service ones. Author (TAB)

N66-10824# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
HEAT TRANSFER CONSIDERATIONS IN THE TEMPERATURE CONTROL OF INSTRUMENTATION PACKAGES AT HIGH ALTITUDES
Arnold Piacentini, Kenneth H. Lindenfelser, and Darrel E. Dube Jun. 1965 32 p refs *Its* Instrumentation Papers, No. 64 (AFCRL-65-380; AD-620838)

A theoretical method for designing thermal packages used to house instrumentation carried aloft by high-altitude balloon vehicles was developed. Because of the odd package shapes and the constantly varying boundary conditions, a numerical method of analysis was employed for the solution of the heat transfer equations. This approach allows the consideration of all pertinent variables, but its complexity requires a large number of computations. Accordingly, the problem was programmed for solution on a high-speed electronic digital computer. The computer program was initially written for a rectangular parallel package. Temperature distributions calculated from the flight-simulation program were compared to temperature distributions measured on actual balloon flights. It was concluded that the method developed is a reliable one. Author (TAB)

N66-10888*# Purdue Univ., Lafayette, Ind. School of Aeronautical and Engineering Sciences.
STUDY OF RECIRCULATING GAS FLOW FIELDS IN THE BASE REGION OF SATURN-CLASS VEHICLES Quarterly Progress Report, 1 May–31 Jul. 1965
Richard F. Hoglund [1965] 85 p
(Contract NAS8-11485)
(NASA-CR-67707) CFSTI: HC $3.00/MF $0.75 CSCL 20M

The project reported on herein is a study of certain chemical and chemical-radiative effects on the base flow field associated with multiple-nozzled launch vehicles of the Saturn-type. The level of effort consists of three graduate students employed on a half-time research basis. Particular subjects under investigation are: 1) delineation of the controlling and energetically most important reactions which occur in the air-combustion product mixing layer to determine the applicable chemical scaling laws; 2) evaluation of various analytical techniques for calculation of the non-similar boundary layer and free shear layer involving finite-rate chemical reactions; and 3) preliminary evaluation of the nature of the effect of energetic chemical reactions on the turbulent stream mixing process. Author

N66-10907# Naval Civil Engineering Lab., Port Hueneme, Calif.
THIN-FILM EVAPORATION IN VAPOR-COMPRESSION STILLS
E. J. Beck Apr. 1965 51 p refs
(R-364; AD-613572)

A study is made to explore promising mechanisms of heat transfer which may be used to develop more efficient sea-water distillation units. As a basis of investigation, an extensive research survey of low-temperature-difference boiling heat transfer is briefly summarized, with the conclusion that with the present understanding of ebullition there is little prospect of achieving the desired heat transfer with active boiling. The metal-to-fluid superheat necessary to form a steam bubble with known types and sizes of nucleation sites prevents ebullition except with minimum temperature differences of 8 to 10F between the temperature of the metal wall and the saturation temperature of the fluid. The concept of evaporation from a very thin film without boiling is considered in detail, and two small experiments are reported. It is shown, both theoretically and experimentally, that very high evaporation rates can be obtained with the very thin film technique; methods of maintaining a thin film continuously in a practical vapor-compression still are considered. A single-tube experiment, in which methods of introducing feed water and checking probable scaling problems will be studied, is described as the next phase of this task. Author (TAB)

N66-10932# National Bureau of Standards, Washington, D. C.
TABLES OF THERMODYNAMIC PROPERTIES OF NITROGEN IN CHEMICAL EQUILIBRIUM INCLUDING SECOND VIRIAL CORRECTIONS FROM 2000° K TO 15000° K
Joseph Hilsenwrath and Max Klein Arnold AF Station, Tenn., Arnold Eng. Develop. Center, Mar. 1964 169 p refs
(AEDC-TDR-63-162; AD-432210)

Tables for the thermodynamic properties for nitrogen are presented which take into account the effect of dissociation and ionization and the limiting-law Debye-Hückel and second virial corrections, upon the thermodynamic properties and the equilibrium compositions. Values are tabulated from 2000° K in steps of 100° K to 15000° K at close spacings in the logarithm of the density [$\log_{10} \rho/\rho_o = -7.0\ (0.2)\ 2.4$] for the compressibility factor $Z = PV/RT$; the dimensionless functions for: internal energy, E/RT; enthalpy, H/RT; entropy, S/R; $\log_{10} P$ (atm) and $Z^* = \Sigma C_i$. The underlying equations and the input data are discussed briefly. The effects of the real gas corrections on the equilibrium properties are illustrated graphically. The equilibrium composition is given for selected temperatures over the tabulated density range. The wide range of temperatures and densities over which the thermodynamic properties have been tabulated make the tables useful in a variety of engineering design and test programs, and in scientific research and development. Author

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34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N66-10099# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 229
Li Ping-Ch'uan 26 Oct. 1965 27 p Transl. into ENGLISH from Chinese Periodicals
(JPRS-32557; TT-65-33036) CFSTI: $2.00

This report is concerned with the methods and production procedures in the science and technology of China. It covers mathematics and operations research used to serve production, the design and production of medical instruments and devices, a study of hemp production, the performance of aviation instruments, and the use of sonar and sound weapons. C.L.W.

N66-10151# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
Feb. 1965 62 p refs
(PB-166681)

CONTENTS:

1. PASSIVE THERMAL CONTROL IN A SPACE ENVIRONMENT A. L. Alexander p 1–9 refs (See N66-10152 01-33)
2. SCATTERING OF POLARIZED NEUTRONS BY SPIN WAVES IN MAGNETITE G. A. Ferguson, Jr., A. W. Sáenz, and A. D. Anderson p 10–19 refs (See N66-10153 01-26)
3. APPLICATIONS RESEARCH p 20
4. ATMOSPHERE AND ASTROPHYSICS p 20–23 refs
5. CHEMISTRY p 23–28 ref
6. MECHANICS p 28–38 refs
7. METALLURGY AND CERAMICS p 39–49 refs
8. RADIO p 49–50
9. SOLID STATE PHYSICS p 50–56 refs

N66-10224# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ROCKETS IN THE DEFENSE OF PEACE

V. Datsenko, M. Mryakin, and I. Izmaylov 13 Aug. 1965 7 p Transl. into ENGLISH from Russian

(FTD-TT-65-967/1+4; AD-620759)

The combat might of the armed forces of the Soviet Union are the rocket forces for strategic purposes. They are deployed with ballistic rockets having medium, intercontinental, and orbital ranges. Soviet rocket construction has provided their army with rockets which operate on new, highly effective types of fuel, including the solids. It was stated that this achieved a simplicity and reliability of rocket exploitation, including the time involved for launch preparations, so as to retaliate immediately if the aggressor has decided on war. It was also stated that rockets occupy a valuable place in the military forces. A basic type of weapon for strategic bombers, fighter bombers, and all-weather fighter interceptors are the rockets of the air to ground class and also those for air to air. R.W.H.

N66-10413*# National Aeronautics and Space Administration, Washington, D. C.

DICTIONARY OF TECHNICAL TERMS FOR AEROSPACE USE

William H. Allen, ed. 1965 310 p refs 1st ed.

(NASA-SP-7) GPO: HC $3.00; CFSTI: MF $1.75 CSCL 05B

A dictionary of technical terms for aerospace usage which is designed for use by a person with a scientific or engineering education who is writing or reading in a field outside his own specialty has been compiled by NASA. It covers terms relevant to both those fields concerned with the space environment and those concerned with space operations. In addition, selected terms for the basic sciences and mathematics which were used frequently in the definitions are included. G.A.L.

N66-10657# Brookhaven National Lab., Upton, N. Y.

ANNUAL REPORT NO. 14, JULY 1, 1964

Dec. 1964 243 p

(Contract AT-(30-2)-GEN-16)

(BNL-867(AS-18)) CFSTI: $6.00

Research progress is reported on a wide range of subjects in the physical and biological sciences and in engineering, but which are all concerned with the development and exploitation of nuclear science and technology. Included are fundamental studies of atomic nuclei, the particles that constitute them, and the forces involved in their structure; studies of the physical, chemical, and biological effects of nuclear radiation; the use of nuclear tools such as neutrons, charged particles, gamma rays, and isotopic tracers in all branches of scientific research; research and development directed toward solving the problems of atomic energy development; and the development of specific devices for use as research tools or in practical application of atomic energy. R.N.A.

N66-10759*# Florida Univ., Gainesville. Bureau of Economic and Business Research.

TRENDS IN THE INDUSTRIAL AND OCCUPATIONAL COMPOSITION OF THE LABOR MARKET IN THE CAPE KENNEDY AREA

Norman G. Keig 28 May 1965 24 p

(Grant NsG-507)

(NASA-CR-67624) CFSTI: HC $1.00/MF $0.50 CSCL 05C

A study was conducted to determine the effect of the federal government's space program on industrial and occupational trends in the labor market of the Cape Kennedy region. R.N.A.

N66-10809# Northwestern Technological Inst., Evanston, Ill.

DATA, MODELING AND DECISION

A. Charnes and W. W. Cooper Jun. 1965 12 p refs Prepared jointly with Carnegie Inst. of Tech. *Its* Systems Res. Memo-127

(Contracts Nonr-1228(10); Nonr-760(24))

(AD-620172)

Past experience with models—and related methods of analysis—may be an inadequate guide for managers considering a use of new tools now available. The latter, viewed as multiple-variable systems models, may differ in their data requirements and decision possibilities in comparison with predecessors that could handle only a few variables at a time. In approaching these new tools it is desirable to consider using the models as guides to data collection as well as decisions. This refers not only to data variety but also to data quality as judged by reference to the model itself. It may then be possible to eliminate needless expenditures of time and money on collecting or refining data. It is also desirable to consider integrating the modelling and decision making. Evaluations may then be secured which can guide alterations to the model and also open new decision possibilities which would otherwise not be apparent. The value of such a joint approach to data, models and decisions is examined and illustrated in the following article with special reference to media mix and new products marketing applications. Author (TAB)

N66-10913# RAND Corp., Santa Monica, California.

A PROPOSAL FOR CONTROL OF LOCAL SERVICE SUBSIDIES

H. R. Swaine Jul. 1965 25 p refs

(P-3184; AD-619712)

The discussion is directed toward a means of introducing competition into the granting of monopoly routes to local airline industries. The basic feature of the proposal is the division of the existing local service routes into two categories. The first category would consist of those relatively profitable routes which the present local service airlines are willing to operate without the benefit of direct federal subsidy payments. The second category would consist of the remaining local service routes which would continue to be subsidized by federal funds. TAB

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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